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# Theory and Construction Methods for Large Regular Resolution IV Designs

A Dissertation

Presented for the

Doctor of Philosophy

Degree

University of Tennessee, Knoxville

Robert M. Block

August 2003

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# Dedication

To my family, thank you for all the love and support.

## Acknowledgements

I wish to express my deepest gratitude and thanks to my advisor, Dr Robert Mee.

I have cherished the many hours spent in his office discussing not only designs of experiments, but life's challenges as well. Without his help, this work would not have been accomplished.

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### Abstract

We define  $2^{k-p}$  fractional factorial designs which use all of their degrees of freedom to estimate main effects and two-factor interactions as second order saturated (sos) designs. We prove that resolution IV sos designs project to every other resolution IV design, and show the details of these projections for every n = 32 and n = 64 run fraction. For k > (5/16)n, all resolution IV designs are a projection from the even sos design at k = n/2. For  $k \le (5/16)n$  the minimum aberration design resolution IV designs are projections of sos designs with both even and odd words in the defining relation. While even resolution IV designs are limited to estimating fewer than n/2 two-factor interactions (in addition to the k main effects), resolution IV designs with odd-length words in the defining relation may devote more than half of their degrees of freedom to two-factor interactions. We propose a method to search for good resolution IV designs using naïve projections from even/odd sos designs. We introduce the alias length pattern as a tool to help characterize designs. We describe how the matrix T = DD' for a design D is useful in searching for designs. We list the resolution IV even/odd minimum aberration designs for n = 128 and provide a catalog of the best resolution IV even/odd designs for n = 128. These results are based on an isomorphic check using a convenient function of T, as well as the set of projections of a design. Finally, we suggest a new method for finding good regular resolution IV designs for large n > 128 and provide a preliminary table of good resolution IV even/odd designs for n = 256.

Key words: alias length pattern, defining contrast subgroup, Hamming distance matrix, isomorphism, minimum aberration, projection, regular designs, word length pattern.

# Disclaimer

The views expressed in this dissertation are those of the author and do not reflect the official policy or position of the United States Air Force, Department of Defense, or the U.S. Government.

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### 1. Introduction

Two-level fractional factorial designs are widely used to investigate the effect of large numbers of parameters for complex computer models. Each parameter is varied over a high and low setting of possible operating conditions to build a model to help explain the relationship of the parameters to the outcome of the computer model. A  $2^{kp}$  fractional factorial design with k parameters or factors at two levels will consist of  $n = 2^{kp}$  runs. This design is a  $2^{p}$ th fraction of the  $2^{k}$  full factorial design where the fraction is determined by p defining words. A "word" consists of "letters" which are the names of the factors denoted by A, B, ... (or 1, 2, ...,). The number of letters in a word is the word length. The group formed by the p defining words and their generalized interactions is called the defining contrast subgroup (Wu and Hamada 2000, p.157). The defining contrast subgroup consists of  $2^{p}$  -1 words plus the identity column (commonly denoted as I). The defining contrast subgroup can be used to study all the aliasing relations among effects.

Every regular design can be categorized by the word length pattern of its defining contrast subgroup. For a  $2^{k\cdot p}$  design, let  $w_i$  denote the number of words of length i in its defining contrast subgroup. The vector  $wlp = (w_1, ..., w_k)$  is called the word length pattern of the design. The resolution of a  $2^{k\cdot p}$  design is defined to be the smallest r such that  $w_r \ge 1$ . This means the length of the shortest word defines the resolution. Box and Hunter (1961) proposed the maximum resolution criterion as a method to categorize and compare designs. Later, Fries and Hunter (1980) introduced the minimum aberration criteria. This criterion allows any two designs to be rank ordered according to their word

length patterns. This is the most common criterion used today to judge the goodness of designs.

In addition to wlp, we introduce a new criterion based on the alias length pattern to help find and characterize resolution IV designs. We define the alias length pattern as the frequencies of the lengths of the alias sets for two-factor interactions:  $alp = (a_1, a_2, ..., a_l)$  where  $a_1$  is the number of clear two-factor interactions,  $a_2$  is the number of pairs of aliased two-factor interactions, etc., up to  $a_l$  which is the number of the largest set of l aliased two-factor interactions  $\left(l \le \left|\frac{k}{2}\right|\right)$ , we define this value as  $L_{\max}$ . The alias length pattern (alp) also contains other important information:

- - The number of degrees of freedom for two-factor interactions:  $\sum_{i=1}^{n} a_{i}$
  - The number of length four words in the defining relation:  $w_4 = \sum_{i=0}^{l} {i \choose 2} a_i / 3$ .

All regular  $2_{IV}^{k-p}$  designs of size n = 64 or less have been identified previously; see Chen, Sun and Wu (CSW) (1993) and Sun (2001). However, for n = 128, all possible resolution IV designs have not been identified. Butler (2003) provided theory for constructing regular minimum aberration designs with n runs and 5n/16 < k < n factors. We have identified all remaining minimum aberration designs for n = 128, that is, for  $k \leq 5n/16$ .

For cases with n = 128 or more, search algorithms are currently used to identify attractive fractional factorial designs having the specified size and other characteristics. For example, PROC FACTEX in SAS/QC<sup>®</sup> software (SAS Institute Inc., 1999) searches for minimum aberration designs for any given  $k < 2^r$ . However, due to the magnitude of the computation for large n and certain values of k, exhaustive searches are not feasible given current computing speeds. The FACTEX procedure returns the best design it finds in the allotted search time. It does not necessarily find the minimum aberration design. This paper will propose an alternative search method for tabulating good designs for n = 256 and larger.

It is well known that, for  $k \le n/2$  factors and n = 8, 16, 24, 32, ..., there exist resolution IV designs. When k = n/2, the design is known as a minimal design of resolution IV (Montgomery 2001, p. 347). These minimal designs may be obtained by foldover of a saturated orthogonal main effects design of size n/2. For any  $n = 2^r$  (with  $r \ge 3$ ), a regular minimal design may be constructed by using all the odd interactions of the r basic columns as generators. For example, for r = 5, the 11 generators for the  $2^{16-11}_{IV}$  design are the  $\binom{5}{3} = 10$  three-factor interactions and the single five-factor interaction.

Alternatively one may arrange the n-1 columns of a saturated main effects design in Yates order (e.g., see Appendix A), and:

- select every other column starting with the first or
- select the last n/2 columns.

Li and Mee (2002) present an alternative set of n/2 columns to create this minimal design. For the remainder of this article, we restrict our attention to regular resolution IV designs.

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The minimal  $2_{IV}^{k-p}$  designs are even designs, in that every word in the defining relation is of even length. Li and Mee (2002) showed that every  $2_{IV}^{k-p}$  design with  $5n/16 < k \le n/2$  must be an even design. Even designs:

- alias even effects with other even effects, and odd effects with odd.
- allocate n/2 degrees of freedom to odd effects, and n/2 1 degrees of freedom to even effects
- provide at most n/2 1 degrees of freedom for estimating two-factor interactions, and at least n/2 k degrees of freedom for three-factor or higher-order interactions.

For instance, the minimum aberration  $2_{IV}^{11-6}$  design - an even design - permits estimation of 11 main effects, 15 two-factor interactions, while leaving five degrees of freedom for aliased three-factor interactions.

By contrast,  $2_{IV}^{k-p}$  designs with half of the words in the defining relation with odd length may provide more than n/2-1 degrees of freedom for two-factor interactions. For instance, the minimum aberration  $2_{IV}^{10-5}$  design supports estimation of all 10 main effects and 21 two-factor interactions. Because of this greater capacity for estimating two-factor interactions, this work will focus on the construction of even/odd  $2_{IV}^{k-p}$  designs. While such designs do not exist for n = 16 and are rather rare for n = 32, even/odd designs are common for larger n if  $k \le 5n/16$ .

One of the challenging aspects of searching for new designs is determining when two designs are equivalent or isomorphic. (Two designs are isomorphic if the defining relation of one can be mapped into the defining relation of the other through a relabeling of the factors and level exchanges.) Draper and Mitchell (1967, 1968, 1970) wrote a series of three articles which used an algorithm to determine isomorphic designs. Their original method, called "sequential conjecture" (1967) found a relabeling map for isomorphic designs. They noted in their next paper (1968) that word length pattern did not uniquely identify designs but it provided an alternative to their permutation subroutine (sequential conjecture procedure) for testing isomorphic designs when the time required to conduct the isomorphic checks become prohibitive. The trade-off of using word length pattern is that the designs found may not be a complete set. Draper and Mitchell (1970) introduced the "letter pattern comparison" (now commonly known as the letter pattern matrix) as a way to identify designs instead of the computationally burdensome sequential conjecture procedure. They make the conjecture that the letter pattern matrix approach uniquely determines designs. Chen and Lin (1991) provide a counter-example to this conjecture. Additional counter-examples appear later in section 11 in this dissertation.

Chen, Sun, and Wu (1993) developed an algorithm for constructing regular fractional factorial designs that required a complete mapping for each design that shared word length pattern. This method insured that no non-isomorphic designs were lost, but became computationally infeasible for n = 128 or larger.

Sun, Li, and Ye (2002) proposed a sequential method for constructing non-isomorphic orthogonal designs and an algorithm for detecting isomorphic designs for both regular and non-regular designs. Their algorithm is based on the concept of *minimal column base*. A column base is a subset of columns of a design, such that no two rows are identical to each other. A minimal column base is the smallest possible number of

columns for a given design. Sun, Li, and Ye check the mapping for the minimal column bases for two designs with the same word length pattern. They repeat this until an isomorphic mapping is found or all the possible minimal bases for the two designs have been checked. See Sun, Li, and Ye (2002) for details. This method is successful for both regular and non-regular designs and especially useful for designs with small n.

In the following section, we focus on the structure of even/odd resolution IV designs of size 32 and 64. We use these known cases to introduce some definitions and indicate the structure one could exploit in the larger cases where all designs are not known.

# 2. Resolution IV Designs of Size 32 and 64

Only five even/odd  $2_{IV}^{k-p}$  designs of size 32 exist; refer to Table 2.1. For convenience, we use Chen, Sun, and Wu's method of labeling designs where 10-5.1 designates the first (best) 32 run design with ten factors and five generators. Two of these designs (10-5.1 and 9-4.2) utilize all 31 degrees of freedom for estimating main effects and two-factor interactions. We will refer to any  $2_{IV}^{k-p}$  design (both even and even/odd designs) that uses all of its degrees of freedom for estimating main effects and two-factor interactions as a second order saturated (sos) design. Each of the non-sos designs is a projection of at least one of these sos designs. For instance, delete any column from 10-5.1 and one obtains design 9-4.1.

Theorem 2.1: Every  $2^{k-p}$  non-sos resolution IV design is the projection of at least one sos resolution IV parent design.

Suppose there exists a  $2_{IV}^{k-p}$  non-sos design. A non-sos design is defined as a design that does not utilize all  $2^{k-p} - 1$  degrees of freedom for estimating main effects and two-factor interactions.

Table 2.1: Even-Odd Resolution IV Designs of Size 32

Design	Generators	df	wlp	alp	E/O Projections
10-5.1	7, 11, 19, 29, 30	31	10,16,0,0,5	0,20,0,0,1	9-4.1
9-4.1	7, 11, 29, 30	30	6,8,0,0,1	8,12,0,1	8-3.1
9-4.2	7, 11, 13, 30	31	7,7,0,0,0,1	15,0,7	8-3.1
8-3.1	7,11,29	29	3,4	13,6,1	7-2.1
7-2.1	7, 27	25	1,2	15,3	

A non-sos design therefore has "available columns" for the unused degrees of freedom.

An available column is any column that is not aliased with a main effect or two-factor interaction.

Suppose we add a new factor to our design, with an available column as its generator. The new factor "z" multiplied by its generator will appear as an additional word in the defining contrast subgroup. The new word is necessarily of length four or more and the resulting design with k+1 factors must be resolution IV for the reason given below.

Suppose it is not resolution IV; then this would mean there is a word in the defining contrast subgroup of length three or less. This implies that a new word contains z (since z appears in all the new words) plus two or fewer other letters. This implies that z is aliased with either a main effect or two-factor interaction, which contradicts the fact that the generator was an "available column". Therefore the resulting k+1 factor design must be resolution IV.

Now this k+1 factor resolution IV design is either a second order saturated design with no more available columns, or a non-sos design with an available column. If not sos, the process can be repeated until the design becomes a second order saturated design. Therefore, all non-sos  $2_{IV}^{k-p}$  designs have at least one resolution IV sos parent.

Corollary 2.1: All non-sos even/odd resolution IV designs are the projection of an even/odd resolution IV sos design.

Even/odd designs may project to either an even design or an even/odd design while even designs only project to other even designs (see Figure 2.1).

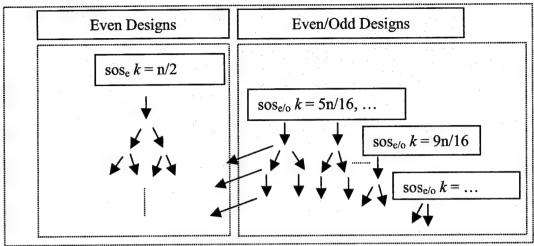


Figure 2.1: Schematic of Projections

<u>Lemma 2.1:</u> If the delete-one-column projections of an even/odd resolution IV design include multiple even designs, the even designs must be isomorphic.

We know that an even design will have all even length words in the defining relation while an even/odd design has  $2^{p-1}$  odd-length words and  $2^{p-1}-1$  even-length words. If an even/odd design projects to an even design, then all the odd length words have been removed. Note that the projected even design may be written as a  $2^{(k-1)-(p-1)}$ ; so half of the words in the defining relation have been removed. Therefore all the odd length words must contain the deleted column. Any other even projection must be isomorphic.

Table 2.1 includes the generators, degrees of freedom (for main effects and two-factor interactions), word length pattern (wlp) and the alias length pattern (alp) for each of the 32-run even/odd designs. For example, design 9-4.1 has  $a_1 = 8$  clear two-factor interactions,  $a_2 = 12$  pairs of aliased two-factor interactions,  $a_4 = 1$  set of four aliased two-factor interactions, and 9 + 21 = 30 degrees of freedom for main effects and two-factor interactions.

The catalog of designs in Appendix B shows all 148 even/odd  $2_{IV}^{k-p}$  designs of size 64. Here we use our own notation to identify the designs since CSW (1993) did not list all the n = 64 designs in their catalog and their ordering did not accord with any obvious criteria. We rank the alternative  $2_{IV}^{k-p}$  designs for a given k using the following criterion:

- 1. Smaller w<sub>4</sub>
- 2. For designs with the same w4, smaller w5
- 3. For designs with the same  $(w_4, w_5)$ , larger  $a_1$

To avoid confusion with the CSW numbering, we use the letters a, b, ... rather than numerals to index the designs. Table B.1 does include a column identifying the CSW number for those designs that are included in their 1993 catalog.

We make the following observations regarding the catalog in Appendix B. First, there are only eight even/odd second order saturated resolution IV designs of size 64:

- 20-14.a
- 18-12.c
- 17-11.b,d,e,g,j
- 13-7.b

Second, a non-sos design in Appendix B may be the projection of more than one sos design. For instance, 16-10.b is the projection of either sos design 17-11.b or 17-11.d.

Note that each n = 8, 16, 32, ... there is only one even resolution IV second-order saturated (sos) design, the minimal design with k = n/2. Thus, the following results are apparent:

- For n = 8 and 16, there exists only the unique even sos design with k = n/2.
- For n = 32, there exist three sos designs, with k = 9, 10, and 16.
- For n = 64, there exist nine sos designs, with k = 13, 17, 18, 20, and 32.

The sos designs with the smallest k are of particular interest because these designs provide the most degrees of freedom for two-factor interactions. We examine the 9-4.2 and 13-7.b designs now. Design 9-4.2 has  $w_4 = 7$ , and these length-four words involve only seven of the nine factors. Thus, all the interactions involving two factors are clear. This design is structured as  $\frac{1}{2} \left[ 2_{IV}^{7-3} \times 2^2 \right]$ , where the one-half fraction of the product array is obtained by dividing each smaller design into two blocks and then taking only two of the four block combinations (see Figure 2.2) where the  $2_{IV}^{7-3}$  has generators 6 = 123, 7 = 124, 8 = 134. Note that the product array above is fractionated using I = +23459.

Design 13-7.b has similar structure:  $\frac{1}{4} \left[ 2_{IV}^{7-3} \times 2_{IV}^{6-2} \right]$ , with each 16-run sub-design divided into four blocks (see Figure 2.3). Butler (2002a) describes these types of designs as joint designs; see also Miller (1997).

		2 <sup>2</sup>	
		I = -59  (2 runs)	I = 59 (2  runs)
$2_{IV}^{7-3}$ with	I = -234 (8  runs)	8x2=16 runs	
	I = 234 (8  runs)		8x2=16 runs

Figure 2.2: Design Structure for 9-4.2

		$2_{IV}^{6-2}$ with $\underline{11} = 56\underline{10}$ and $\underline{13} = 56\underline{12}$						
		$6\underline{11} = +$ $6\underline{11} = +$ $6\underline{11} =  6\underline{11} = -$						
	<u>,                                    </u>	$6\underline{1013} = +$	6 <u>1013</u> = –	$6\overline{1013} = +$	$610\overline{13} = -$			
	1 = +	$4 \times 4 = 16 \text{ runs}$						
$2_{IV}^{7-3}$ with	234 = +							
7=123,	1 = +		$4\times4=16$ runs					
8=124,	234 = -							
9=134	1 = -			$4\times4=16$ runs				
	234 = +							
	1 = -				$4\times4=16$ runs			
	234 = -				1014110			

Figure 2.3: Design Structure for 13-7.b

# 3. Projection Design Search Method

The difficulty of finding minimum aberration designs (and other good designs) increases dramatically as the size of the designs grows. As n becomes larger, it is no longer feasible to conduct exhaustive searches. One option is to intelligently reduce the number of designs that must be investigated. The value of sos designs is they represent a small fraction of all possible resolution IV designs and project to all the remaining possible resolution IV designs. Thus from these designs one can project to minimum aberration and other good designs. If all the sos designs for a given n can be found and identified, then we have the starting points for all resolution IV even or even/odd designs for a given n.

Our first attempt to find minimum aberration and other good designs was to find all the sos designs for a given run size n and then project from those designs to identify the best designs. To accomplish this requires the ability to find sos designs, distinguish non-isomorphic sos designs, and then to determine the best projections.

The first issue is feasible at n = 128. It appears to be possible to find the sos designs at n = 128. Projections of these sos designs lead to weak minimum aberration designs and careful evaluation of all sos designs would determine minimum aberration for any  $k \le 64$  at n = 128. There are 88 unique sos designs at n = 128. However to find the minimum aberration design, one must evaluate all possible sequence of projections; this combinatorial problem currently becomes computationally infeasible beyond ten or more projections. Therefore the projection search method is limited in its usefulness for conducting an exhaustive search; in addition, the number of sos designs explodes at higher n. For instance, there are at least 34,015 (and possibly twice that many) sos

designs at n = 256 (see section 13). Thus we found it necessary to pursue alternative methods.

### 4. Detecting Isomorphic Designs

To successfully find minimum aberration designs requires a computationally fast and efficient method to find and compare designs, as well as some ability to quickly identify isomorphic designs.

When searching for designs, most of the time is spent evaluating isomorphic designs. CSW (1993) were not able to distinguish all n = 128 designs beyond k = 11 because of the time required to find a complete relabeling of columns for every isomorphic design check. At n = 128 with k = 11 factors, there are 2,597 sets of four generators that produce a resolution IV designs. Of these designs, there are only 92 non-isomorphic designs. This is the last step CSW completed (Sun 2001). Consider at k = 17 we have found 14,438 unique resolution IV designs, and a total of 302,384 sets of ten generators producing a resolution IV design. Thus, on average, there are more than 20 ways to construct each unique design and the number of designs to compare is two orders of magnitude greater.

Two fractional factorial designs are isomorphic  $(D_1 \cong D_2)$  if one design can be obtained from the other design by relabeling the factors, reordering the runs, or switching the levels of factors (Chen and Lin 1991). Clark and Dean (2001) present a necessary and sufficient condition for two designs to be isomorphic based on a geometrical representation of the designs. Let D represent an  $n \times k$  design matrix with n runs, k factors, and levels  $\pm 1$ . Let T(D) = DD', which is related to the Hamming distance matrix H, since  $T = kJ_k - 2H$  where  $J_k$  is a  $k \times k$  matrix of unit elements. Note that for any design D, the (i, j)<sup>th</sup> element of T, denoted as  $T_{ij}(D)$ , is equal to the inner product of

the  $i^{th}$  and  $j^{th}$  rows of D. Clearly  $T_{ij}(D) = k$  for i = j. Other properties of T are discussed in sections five and six. We now describe a result from Clark and Dean (2001) and introduce more notation:

Clark and Dean's Corollary 2.2: Designs  $D_1$  and  $D_2$  are isomorphic if and only if there exists an  $n \times n$  permutation matrix R and a permutation  $\{c_1, c_2, ..., c_k\}$  of  $\{1, 2, ..., k\}$  such that, for q = 1, 2, ..., k:  $T(D_1^{\{1, 2, ..., q\}}) = RT(D_2^{\{c_1, c_2, ..., c_q\}})R'$  where  $D^{\{1, 2, ..., q\}}$  denotes a q-factor subset of the full design including just the listed columns.

We will say that  $T(D_1)$  is equivalent to  $T(D_2)$  [denoted as  $T(D_1) \equiv T(D_2)$ ] if for some permutation matrix R,  $T(D_1) = RT(D_2)R'$ . Define  $D_i^{\{q\}}$  to represent the design with only the  $q^{th}$  column from  $D_i$ . Similarly,  $D_i^{\{\overline{q}\}}$  is the design matrix with all the columns of  $D_i$  except for column q. Observe that  $T_{ij}(D^{\{\overline{q}\}}) = (k-1)$  for i=j. Based on Clark and Dean's Corollary, we have Lemma 4.1:

<u>Lemma 4.1:</u>  $D_1 \cong D_2$  if and only if  $T(D_1) \equiv T(D_2)$  and  $D_1^{\{\overline{q}\}} \cong D_2^{\{\overline{c}_q\}}$  for some integers q and  $c_q$ .

Note that by Clark and Dean's Corollary 2.2  $D_1^{\{\bar{k}\}} \cong D_2^{\{\bar{c}_k\}}$  if and only if there exists R and  $\{c_1,\cdots,c_{k-1}\}$  such that

$$\begin{split} T(D_1^{\{\bar{k}\}}) &= RT(D_2^{\{\bar{c}_k\}})R', \, T(D_1^{\{\bar{k}, \bar{k}-1\}}) = RT(D_2^{\{\bar{c}_k, \bar{c}_{k-1}\}})R', \cdots, T(D_1^{\{l\}}) = RT(D_2^{\{c_l\}})R'. \quad \text{Then} \\ D_1 &\cong D_2 \,, \, \text{if and only if} \, T(D_1) \equiv T(D_2) \, \text{ and } \, D_1^{\{\bar{q}\}} \cong D_2^{\{\bar{c}_q\}} \, \text{ for some integers} \, q \, \text{and} \, c_q \,. \\ &\underline{\text{Lemma 4.2:}} \, \, \{T(D^{\{\bar{1}\}}), \cdots, T(D^{\{\bar{k}\}})\} \, \, \text{determines} \, T(D) \,. \end{split}$$

We show this result for an arbitrary element  $T_{ij}(D)$ . Suppose we have a design D, with k factors and we know the T matrices for the k projections  $\{T(D^{\{\overline{1}\}}), \dots, T(D^{\{\overline{k}\}})\}$ 

for D. Define  $r=\frac{T_{ij}(D)+k}{2}$ . Then for r values of  $l=1,2,\cdots,k$ ,  $T_{ij}(D^{\{\bar{l}\}})=T_{ij}(D)-1$ , and for k-r values of l,  $T_{ij}(D^{\{\bar{l}\}})=T_{ij}(D)+1$ . There are two possibilities for  $T_{ij}(D)$ : The set  $\{T_{ij}(D^{\{\bar{l}\}}),\cdots,T_{ij}(D^{\{\bar{l}\}})\}$  will contain both  $T_{ij}(D)-1$  and  $T_{ij}(D)+1$  values, in which case they bound  $T_{ij}(D)$ ; or the set will contain one constant value, in which case  $T_{ij}(D)=T_{ij}(D^{\{\bar{l}\}})+1$  if  $T_{ij}(D^{\{\bar{l}\}})$  is positive, or  $T_{ij}(D^{\{\bar{l}\}})-1$  if  $T_{ij}(D^{\{\bar{l}\}})$  is negative. Q.E.D.

Lemma 4.2 states that the set of  $\{T(D^{\{\overline{1}\}}), \dots, T(D^{\{\overline{k}\}})\}$  determines T(D). If we are missing one of the projections from that set, we can still determine T(D).

Corollary 4.1: k-1 members from  $\{T(D^{\{\overline{1}\}}), \dots, T(D^{\{\overline{k}\}})\}$  determine T(D).

The proof is as follows: Suppose we have design  $D_i$ , with k factors and we know k-1 of the members from  $\{T(D^{\{\bar{1}\}}), \cdots, T(D^{\{\bar{k}\}})\}$ .  $T_{ij}(D^{\{\bar{q}\}})$  will either increase or decrease the value of  $T_{ij}(D)$  by one. Recall that  $r=\frac{T_{ij}(D)+k}{2}$  and for r values of  $l=1,2,\cdots,k$ ,  $T_{ij}(D^{\{\bar{l}\}})=T_{ij}(D)-1$ , and for k-r values of l,  $T_{ij}(D^{\{\bar{l}\}})=T_{ij}(D)+1$ . If we are missing one projection, we can still determine  $T_{ij}(D)$ . There are two possibilities for  $T_{ij}(D)$ : The set will contain both  $T_{ij}(D)-1$  and  $T_{ij}(D)+1$  values, in which case they bound  $T_{ij}(D)$ ; or the set will contain one constant value, in which case  $T_{ij}(D)=T_{ij}(D^{\{\bar{l}\}})+1$  if  $T_{ij}(D^{\{\bar{l}\}})$  is positive, or  $T_{ij}(D^{\{\bar{l}\}})-1$  if  $T_{ij}(D^{\{\bar{l}\}})$  is negative.

Now we make two conjectures regarding isomorphism of two designs based on isomorphism of their delete-one-factor projections. Let  $D_1$  and  $D_2$  be any regular  $2^{k-p}$  designs with no repeat rows (runs).

Conjecture 4.1: If  $D_1^{\{\bar{i}\}} \cong D_2^{\{\bar{c}_i\}}$  with  $i = 1, 2, \dots, k$ , where  $\{c_1, c_2, \dots, c_k\}$  is any permutation of the integers  $\{1, 2, \dots, k\}$ , then  $D_1 \cong D_2$ .

We know under the following conditions that the conjecture is true: Note that

$$T(D_1^{\{\overline{1}\}}) + \dots + T(D_1^{\{\overline{k}\}}) = (k-1)T(D_1) \text{ and } T(D_2^{\{\overline{1}\}}) + \dots + T(D_2^{\{\overline{k}\}}) = (k-1)T(D_2).$$

Without loss of generality, assume the columns of  $D_2$  are ordered such that

$$\begin{split} D_1^{\{\bar{i}\}} &\cong D_2^{\{\bar{i}\}} \ \forall i \ . \ \text{Then there exists an} \ R_i \ni T(D_1^{\{\bar{i}\}}) = R_i T(D_2^{\{\bar{i}\}}) R_i' \ . \ \text{If} \ R_1 = \dots = R_k = R \end{split}$$
 then  $T(D_1^{\{\bar{i}\}}) = RT(D_2^{\{\bar{i}\}}) R' \forall i \ \text{and} \ \sum T(D_1^{\{\bar{i}\}}) = \sum RT(D_2^{\{\bar{i}\}}) R' \ . \ \text{Then}$  
$$(k-1)T(D_1) = (k-1)T(D_2) \ . \ \text{Thus} \ T(D_1) = T(D_2) \ \text{and} \ \therefore D_1 \cong D_2 \ . \end{split}$$

The key requirement of the conjecture is that  $\{D_1^{\{\tilde{t}\}}\}\cong\{D_2^{\{\tilde{t}\}}\}$  for  $i=1,\cdots,k$  implies  $T(D_1)\equiv T(D_2)$ . We know this requirement is not true in general. In fact, we know that a non-simple design may share the same set of projections as a simple design, but will have a different T matrix. For example consider the  $2^4$  full factorial design and the replicated  $2_{IV}^{4-1}$  fractional factorial design. While they share the same projections, they have different T matrices.

Define  $S \subset \{1, 2, \dots, k\}$  with cardinality s. If Conjecture 4.1 is true, then we suppose that the following stronger conjecture may also be true.

Conjecture 4.2 If two designs  $D_1$  and  $D_2$ , have s projections in common, and these s projections of  $D_1$ ,  $\{D_1^{\{\bar{i}\}}: i \in S\}$  determine  $T(D_1)$ , then  $D_1 \cong D_2$ .

Assume we have two designs,  $D_1$  and  $D_2$ , with s projections in common,  $D_1^{\{\bar{i}\}} \cong D_2^{\{\bar{c}_i\}} \text{ for } i \in S \text{ . If the } s \text{ projections of } D_1, \ \{D_1^{\{\bar{i}\}}: i \in S\} \text{ determine } T(D_1) \text{ , then }$  they also determine  $T(D_2)$  and we suppose  $D_1 \cong D_2$  .

# 5. Advantages and Uses of the T Matrix

Hedayat, Sloane, and Stufken's definition 3.4 (1999) states that an orthogonal array OA(N, k, 2, t) with levels from GF(2) is said to be linear if it is simple (runs are distinct) and if, when considered as k-tuples from GF(2), its N runs form a vector space over GF(2) (i.e., satisfy the condition that if  $R_1$  and  $R_2$  are any two runs of the array then every k-tuple  $c_1R_1 + c_2R_2$  is also a run, for any choice of  $c_1, c_2 \in GF(2)$ ).

It is known that all two-level regular fractional factorial designs are OA(N, k, 2, t) with t = (resolution - 1). All regular fractional factorial designs without repeat runs are simple. Fractional factorial designs with a defining relation (regular design) are a subclass of orthogonal arrays and are linear codes (Hedayat, Sloane, and Stufken p.276). Therefore we can take the sum of any two rows from a regular fractional factorial design and using modulus(2) arithmetic it will equal another row in the design. Note that the element-wise product for two runs with levels  $\pm 1$  is equivalent to modulus(2) arithmetic for the same two runs with levels 0 and 1. Hence, for regular two level fractional factorial design with levels of  $\pm 1$ , any two rows multiplied element-wise will result in another row of the design.

For example consider a  $2_{III}^{5-2}$  regular fractional factorial design where:

and the T matrix is:

$$5 -1 1 -1 -1 1 -1 -3$$

$$-1 5 -1 1 1 -1 -3 -1$$

$$1 -1 5 -1 1 1 -1 -3 -1$$

$$1 -1 5 -1 -1 -3 -1 1$$

$$1 -1 5 -3 -1 1 -1$$

$$-1 1 -1 -3 5 -1 1 -1$$

$$1 -1 -3 -1 -1 5 -1 1$$

$$-1 -3 -1 1 1 -1 5 -1$$

$$-3 -1 1 -1 -1 1 -1 5$$

Note that each column (and row) of T have the same distribution of values. For instance, each column contains the values -3, -1, 1, and 5 with frequencies 1, 4, 2, and 1, respectively.

Theorem 5.1: Any two-level regular factorial design D will have a constant column distribution in T(D).

We now show that the elements of  $t_i^D$  are a permutation of the elements of  $t_j^D$  for arbitrary i and j from  $\{1, ..., n\}$ . We know that  $x_i x_j = x_l$  for some  $l \in \{1, 2, ..., n\}$ , where  $x_i x_j$  is defined as the element-wise product of the i<sup>th</sup> and j<sup>th</sup> rows. Hence,  $x_i x_l = x_j$ .

Now define 
$$t_j^D = D \cdot x_j$$
 where  $x_j'$  is the  $j^{th}$  row of  $D$ , and rewrite  $t_j^D = \begin{bmatrix} x_1'x_j \\ \vdots \\ x_n'x_j \end{bmatrix}$  using the

specified 
$$i^{\text{th}}$$
 and  $j^{\text{th}}$  rows above as  $t_j^D = \begin{bmatrix} x_1'(x_i x_l) \\ \vdots \\ x_n'(x_i x_l) \end{bmatrix} = \begin{bmatrix} (x_1 x_l)' x_i \\ \vdots \\ (x_n x_l)' x_i \end{bmatrix}$ . From the definition of

a group we know that any element from a group multiplied by the group results in the

original group. Therefore this implies that the matrix 
$$=\begin{bmatrix} (x_1x_1)^t x_i \\ \vdots \\ (x_nx_l)^t x_i \end{bmatrix}$$
 contains all the elements of  $t_i^D$ . Q.E.D.

### 6. Functions of the T Matrix

We know from Theorem 5.1 that  $t_1^D$ , ...,  $t_n^D$  are simply different permutations of the same vector. Butler (2003) states that  $T_{ii}(D)$  measures the confounding between the  $i^{th}$  and  $j^{th}$  rows. He defines  $\mu_k = n^{-2} \sum_{i=1}^n \sum_{j=1}^n T_{ij}^k(D)$  as the  $k^{th}$  moment of the elements of the T matrix. Therefore, the moments  $\mu_0, \dots, \mu_k$  provide an overall measure of the confounding between rows of the design (Butler 2003). By Theorem 5.1 we can use any one column of the T matrix to calculate the moments of a regular design. When our use of  $t_i^D$  does not depend on the subscript i, we simply write  $t^D$  to represent an arbitrary column of T. We know from Butler (2003) that the design moments for D can be used to compare and rank designs. The design moments method results in an identical ranking of designs that results from using the word length pattern for designs (Butler 2003). Since the word length pattern and moments of T are both functions of  $t^D$ , it is possible that  $t^D$  might be more discriminating than the moments of a design or equivalently the word length pattern. However; by Theorem 6.1, the frequencies of  $t^D$  can be written as a function of the moments, so  $t^{D}$  is no more discriminating than is the word length pattern.

Let  $f_0,...,f_k$  represent the frequency of values for -k,(-k+2),...,k, respectively, in  $t^D$ .

Theorem 6.1: The frequencies  $f_0,...,f_k$  are a function of the moments  $\mu_0,...,\mu_k$ .

We can write 
$$n\mu_j = \sum_{i=0}^{k} (2i - k)^j f_i$$
 for  $j \in \{0, 1, \dots, k\}$ 

Note that: 
$$n\mu_0 = \sum_{i=0}^k (2i - k)^0 f_i = \sum_{i=0}^k f_i = n$$
. Define  $\mu_j' = \sum_{i=0}^k i^j f_i / n$  and let

$$M = \begin{bmatrix} \mu_0 \\ \vdots \\ \mu_k \end{bmatrix} \text{ and } M^* = \begin{bmatrix} \mu_0' \\ \vdots \\ \mu_k' \end{bmatrix}. \text{ Note that } M = BM^* \text{ where } B \text{ is a lower triangular matrix}$$

with positive values on the diagonal since  $\mu_r = E[2i - k]^r = 2^r E[i^r] - 2^{r-1} r k E[i^{r-1}] + \dots$ =  $2^r \mu_r - 2^{r-1} r k \mu_{r-1} + \dots$  We know that the determinant of a triangular matrix is equal to the product of the elements along the diagonal (Eves, p123). Hence,  $M^* = B^{-1} M$  since the matrix B is nonsingular and can be inverted.

Now write the moments of a design,  $\mu_0, \dots, \mu_k$ , as a system of equations

$$nM^* = AF$$
 where  $F = \begin{bmatrix} f_0 \\ \vdots \\ f_k \end{bmatrix}_{(k+1)\times 1}$  and the coefficient matrix A is:

$$A = \begin{bmatrix} 1 & 1 & 1 & 1 & \dots & 1 \\ 0 & 1 & 2 & 3 & \dots & k \\ 0 & 1 & 2^2 & 3^2 & \dots & k^2 \\ \vdots & \vdots & \vdots & \vdots & \dots & \vdots \\ 0 & 1 & 2^k & 3^k & \dots & k^k \end{bmatrix}_{(k+1) \times (k+1)}$$

The determinant of matrix A can be described as a Vandermonde determinant (Eves p.127). From this literature, it is known that A is nonsingular (since the values of A are integer and increasing [0, 1, ..., k]). Thus A can be inverted, so we can rewrite our system of equations in terms of  $F = A^{-1}nM^*$  and  $F = nA^{-1}B^{-1}M$ . This means the frequencies, F, are a function of the moments M. Therefore the probabilities that generate those

moments are unique and the moments are unique in the sense that any two designs with the same moments M must have identical  $t^D$  frequencies F.

Since word length pattern, or equivalently  $t^D$ , is unsuccessful in distinguishing many designs at n=64 and larger, we are interested in creating a more discriminating function from pairs of columns of T. Let  $T2^D$  represent the set of n pairs of columns of T for D where  $T2^D = \{(t_1^D, t_1^D), (t_1^D, t_2^D), \dots, (t_1^D, t_n^D)\}$ .

Define  $G(T2^D) = \{g(t_1^D, t_1^D), g(t_1^D, t_2^D), \dots, g(t_1^D, t_n^D)\}$ , where  $g(t_1^D, t_n^D) = \sum_{r=1}^n h(T_{rl}T_{rr})$  and h(x) = 0 when  $x \le 0$ , and  $h(x) = x^{-1}$  when x > 0. For example, consider the  $2^{5-2}_{III}$  regular design again. The  $t^D$  vector contains the values -3, -1, 1, and 5, with frequencies 1, 4, 2, and 1, respectively. Figure 6.1 shows the four bivariate frequency distributions that occur for the pairs of columns for T. While the columns of T have identical frequency distributions, the pairs of columns for T do not. For the n pairs  $(t_1^D, t_j^D)$   $j = 1, 2, \dots, n$ , four possibilities occur with frequencies 1, 4, 2, and 1, respectively (see Figure 6.1). Therefore,  $G(T2^D) = \{6.1511, 0.667, 4.4, 0.667, 0.667, 4.4, 0.667, 6.0\}$  for this design. We sort this set for our convenience in comparing designs so that  $G(T2^D) = \{0.667, 0.667, 0.667, 0.667, 0.667, 4.4, 4.4, 6.0, 6.1511\}$ .

We chose to define  $T2^D$  above pairing each of the n columns of T with  $t_1^D$ . We now show that the set  $G(T2^D)$  is invariant to the choice of which column we fix.

Lemma 6.1: For any  $i \in (1, \dots, n)$ ,  $\{g(t_i^D, t_j^D) \ j = 1, \dots, n\} = \{g(t_n^D, t_{r_j}^D) \ j = 1, \dots, n\}$  where  $(r_1, \dots, r_n)$  is a permutation of  $(1, \dots, n)$ .

(1, j) Pairs of T matrix columns:	Biv	aria	te d	istri	buti	on:	$g(t_1^D, t_j^D)$
(1, 1)	-3 -1 1 5 totals	1	4	2	1 1	totals 1 4 2 1 8	= 6.1511
(1, 2) (1, 4) (1, 5) (1, 7)	-3 -1 1 5 totals	1	-1 1 2 1 4	2	1	totals 1 4 2 1 8	= 0.667
(1, 3) (1, 6)	-3 -1 1 5 totals	1	4	1 1 2	1	totals 1 4 2 1 8	= 4.4
(1, 8)	-3 -1 1 5 totals	-3 1 1	4	2	5	totals 1 4 2 1 8	= 6.0

Figure 6.1:  $2_{III}^{5-2}$  T Matrix, Pairs of Columns

Without loss of generality, assume  $x_n$  is the treatment combination with all +1 levels. Then the element-wise product of  $x_ix_j=x_nx_{r_j}=x_{r_j}$  for some  $r_j\in\{1,\cdots,n\}$ . Hence, Lemma 6.1. By this lemma,  $\{g(t_i^D,t_j^D)\ j=1,\cdots,n\}$  is invariant to the choice of i. We defined  $T2^D$  with i=1.

Theorem 6.2:  $D_1 \cong D_2 \Rightarrow G(T2^{D_1}) = G(T2^{D_2})$ 

Since  $D_1 \cong D_2$ , there exists  $\{r_1, \cdots, r_n\}$ , a permutation of  $\{1, \cdots, n\}$ , such that  $T(D_1) = RT(D_2)R'$  where R is the permutatin matrix defined as  $R_{ij} = 1$  if  $j = r_i$ , and zero otherwise. Then  $(t_1^{D_1}, t_j^{D_1}) = (Rt_{r_1}^{D_2}, Rt_{r_j}^{D_2})$  for  $j = (1, \dots, n)$ . So  $g(t_1^{D_1}, t_j^{D_1}) = g(t_{r_1}^{D_2}, t_{r_j}^{D_2})$  for  $j = (1, \dots, n)$ , because the permutation matrix R does not affect the computation of  $g(\cdot, \cdot)$  since we are summing the rows. Then by Lemma 6.1,  $\{g(t_{r_1}^{D_2}, t_{r_j}^{D_2}) \mid j = 1, \dots, n\} = G(T2^{D_2})$  and so  $G(T2^{D_1}) = G(T2^{D_2})$ . Q.E.D.

The set  $G(T2^D)$  uniquely identifies all regular resolution IV designs for n < 128. At n = 128,  $G(T2^D)$  uniquely identifies 296,958 of the 296,960 even/odd designs (it does not uniquely identify 2 even/odd designs) which differ based on their delete-one-factor projections. However, it does distinguish the two  $2_{VII}^{31-16}$  regular designs that are commonly cited from Chen and Lin (1991) as an example of non-isomorphic designs with common letter pattern matrices. See Section 11 for more comparisons with other common criterion.

## 7. Exhaustive Even/Odd Design Search Method

We now present a new method for finding minimum aberration designs using a build up and delete-one-factor projection strategy. As noted previously, CSW were unable to fully enumerate designs beyond k = 11 at n = 128, due to the enormous computations required to perform their isomorphism checks. Our approach for regular factorial designs attempts to take advantage of a simplified isomorphism check. Using Conjecture 4.1 we replace the permutation check for isomorphism from Clark and Dean and check the set of delete-one-factor projections for each design. We save only the unique sets of delete-one-factor projections and the  $G(T2^D)$  set, thus determining our non-isomorphic designs.

If Conjecture 4.1 is not true, then there could exist designs with non-equivalent T matrices that have a common set of delete-one-factor projections. We differentiated designs based on their delete-one-factor projections. We did not check  $G(T2^D)$  simultaneously with the delete-one-factor projections and therefore did not have the occasion to find any designs with isomorphic delete-one-factor projections but different sets of  $G(T2^D)$ , which would provide a counter-example to Conjecture 4.1 for n=128.

The approach is as follows: begin with all non-isomorphic resolution IV designs with k factors. Consider all possible k + 1 factor designs obtained by adding a generator to each k factor design. We then check the k + 1 delete-one-factor projections. If the k + 1 delete-one-factor projections for design  $D_1$  are equal to the k + 1 one-factor projections for  $D_2$  then the designs are considered isomorphic by Conjecture 4.1; otherwise they are non-isomorphic. This process can be repeated as we increase k by one factor at a time.

Using this approach allowed us to complete an "exhaustive" search of even/odd designs at n = 128 for  $k \le 40$ .

Another step to reduce the computational burden at n = 128 was the elimination of the requirement to retain even designs past k = 22. This was possible for the following reasons. Resolution IV  $2^{k-p}$  even/odd designs project to a set of k - m  $2^{(k-1)-(p-1)}$  even/odd designs and m isomorphic  $2^{(k-1)-(p-1)}$  even designs (by Lemma 2.1), where m is defined as the multiplicity for the number of delete-one-factor projections from a  $2^{k-p}$  design that project to a  $2^{(k-1)-(p-1)}$  even design.

We classify m into three cases: When m=0, the set of k projections are all  $2^{(k-1)-(p-1)}$  even/odd designs and by Lemma 4.2 we can determine T(D). When m=1, we use Conjecture 4.2, motivated by Corollary 4.1 and the set of k-1 even/odd  $2^{(k-1)-(p-1)}$  designs to determine D. The last case, when m>1, is determined as follows: We know k-m projections are  $2^{(k-1)-(p-1)}$  even/odd designs and m projections are isomorphic  $2^{(k-1)-(p-1)}$  even designs. Without loss of generality, suppose  $D^{\{i\}}$   $i=1,\cdots,m$  are  $2^{(k-1)-(p-1)}$  even designs, and the remaining k-m projections are  $2^{(k-1)-(p-1)}$  even/odd designs. Then  $G(T2^{D^{\{i\}}})$ , m, and  $D^{\{i\}}$  (i>m) determine D (up to isomorphism). The reason is as follows: for n=8, 16, 32, and 64, we know that  $G(T2^D)$  uniquely distinguishes all  $2^{k-p}_{IV}$  designs. For n=128, even  $2^{(k-1)-(p-1)}_{IV}$  designs projected from  $2^{k-p}_{IV}$  designs with  $m \ge 2$ , permit us to distinguish D by  $G(T2^D)$  since the even  $2^{(k-1)-(p-1)}_{IV}$  designs can be written as the product array  $2^1 \times 2^{(k-2)-(p-1)}$  and so all are uniquely distinguished by  $G(T2^D)$ .

## 8. Resolution IV Designs of Size 128

We characterize the even/odd resolution IV design for n = 128 using five criterion:

- wlp (minimum aberration)
- Maximum degrees of freedom used for main effects and two-factor interactions
- Minimium L<sub>max</sub> (the length of the longest two-factor interaction alias chain)
- Maximum number of clear two-factor interactions
- Minimum CD2 (the unique portion of the centered L2 discrepancy from Ma,
   Fang, and Lin 2001).

The minimum aberration designs for  $k \le 40$  at n = 128 are listed in Table 8.1 along with the above criteria and their respective ranking. The complete alp is also provided for each design. Appendix C contains a catalog of the best even/odd designs and their rankings for k = 8, ..., 40 with respect to our various criteria.

Our exhaustive search of even/odd designs found not only the minimum aberration designs, but also a number of interesting results. All minimum aberration designs from  $10 \le k \le 40$  are even/odd designs. We found that the uniform centered design criteria (Ma, Fang, and Lin 2001) is closely related to the word length pattern. Our calculation of the minimum CD2\* value agreed with the minimum aberration design in all but four cases; in those cases, the minimum aberration value was the second smallest CD2\* value.

Table 8.1: Minimum Aberration Regular Resolution IV (or higher) Designs for n = 128

2 16 13 24 3 3 24 3 3 24 3 3 24 3 3 24 3 3 24 3 3 24 3 3 24 3 3 24 3 3 2 3 3 3 3	W <sub>6</sub> W <sub>7</sub>	w <sub>8</sub> 1 28 36 45 55 60 3 66 6 73 9 63 21 60 30 46 45	36 55 55 55 75 85 96 96 106 110	CZF1 CZF1 65 55 55 55 55 55 55 55 55 55 55 55 55	Lmax d	rank 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2	CCZF1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Lmax rank 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	55.09 49.59 44.63 36.16 32.55 29.30 26.39 23.77 19.30	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
120 152 200 248 316 482 482 690 690 972	235 340 414 414 572 744 992 1704 1704 2800 3472 4662 5876	36 54 9 24 60 14 1 26 54 15 4 3 25 36 32 8 0 1 12 52 24 9 2 2 1 0 54 16 24 0 4 0 64 0 18 20 0 29 41 4 16 8 0 15 55 0 12 16 0 0 70 0 0 0 28 0 0 70 0 0 0 28 0 0 0 0 40 40 0 0 0 0 2 5	118 119 123 124 125 127 127 127 127 127 127 128	25 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	2117000001111		2807 28084 17819 14585 32307 27865 20240 13068 3930 1914 799	1 1 45 942 5495 1 1 1 1 1 1 1 1 8 9	17.40 15.69 14.17 12.80 11.57 10.46 9.469 8.579 7.779 7.061 6.431 5.866	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~
		0 12 48 0 12 48 0 0 24 5 0 0 0 0 7 0 0 0 0 0 0 0 0 0 0	119 120 121 122 123 124 125 126	,00	19	130 67 67 111 11 11 11	67	446 11 11 11 11	4.891 4.478 4.108 3.776 3.216 2.979 2.576	222

No minimum aberration designs have any clear two-factor interactions beyond k = 23, although we found designs with clear two-factor interactions up to k = 33. We know from Chen and Hedayat (1998) that designs with clear two-factor interactions exist only if  $k \le n/4 + 1$ . In general, as the number of factors increases, the number of good designs (based on word length pattern) with clear two-factor interactions decreases.

There exist 296,960 even/odd non-isomorphic resolution IV (or higher) designs for n = 128 (see Table 8.2). There are also 88 resolution IV sos designs, and all but one of the sos designs are even/odd designs. We also now know that sos designs may have the same word length patterns but different alp and may even share the same word length pattern as other non-sos designs. For instance, consider the three designs at k = 33, where the two sos designs 33-26.42b and 33-26.42c share identical word length patterns with design 33-26.42a which is not an sos design. All three designs have different alias length patterns.

We also found two notably good sos designs: k = 29, and k = 40. The design at k = 40 is well known and many of its projections lead to other minimum aberration designs. The sos design at k = 29 has a remarkably smaller number of length-four words than any other k = 29 design and several of the sos design's projections are also minimum aberration designs. In particular, the minimum aberration designs can be found by projecting from sos designs at k = 29 or k = 40 for k = 40, 39, ..., 26, 24, 16, 13, 11, 10, and 9 (see Section 12).

It is interesting to note that for  $k \le 40$ , the minimum aberration design word length pattern for each k is indeed unique, which supports the conjecture that the word length pattern is unique for minimum aberration resolution IV designs. In fact, only

Table 8.2: Existence of Resolution IV designs

8.2:	<b>Existence of Resol</b>	ution IV desig	ns	
$\overline{k}$	# of even/odd	# of even	# of even/odd	# of even
	designs,	designs,	designs,	designs,
	n = 64	n = 64	n = 128	n = 128
7	2	2	-	-
8	3	4	2	3
9	6	6	7	6
10	12	12	19	14
11	20	14	62	30
12	22	21	180	69
13	24	23	487	136
14	20	29	1,240	295
15	15	29	2,926	596
16	11	37	6,208	1,292
17	10	30	11,787	2,651
18	3	30	19,466	5,598
19	1	24	27,994	11,341
20		23	35,192	22,728
21	-	16	39,201	43,516
22	-	15	38,847	79,603
23	-	9	34,868	?
24		8	28,133	?
25		5	20,569	?
26		4	13,498	?
27		2	8,075	?
28		2	4,284	?
29		1	2,149	?
30		1	976	?
31	-	1	433	?
32	-	1	197	?
33	-	-	101	?
34	<b>.</b> -	-	31	?
35	_	-	13	? ? ? ? ? ? ? ? ?
36		-	8	?
37		-	3	?
38	_	-	2	?
39	<b>-</b>	-	1	
40	-	-	1	?

at k = 31, does one have to go beyond length-5 words in the defining relation to differentiate minimum aberration designs from weak minimum aberration designs.

Finally, the  $L_{\rm max}$  results show that it is impossible to create an n=384 3/4-design (John 1962) for  $k\geq 20$  from resolution IV fractions, since  $L_{\rm max}>3$ . Also many of the better designs based on word length pattern are also ranked in the best designs according to  $L_{\rm max}$ . For example, the top eight designs based upon word length pattern are also the top eight ranked designs for  $L_{\rm max}$  at k=18.

# 9. Incomplete Enumeration of Designs Based on Word Length Pattern

As the size of n increases, more and more computer resources are required to fully enumerate designs. The next two sections explore computationally simpler (imperfect) isomorphism checks in order to evaluate their potential merit for n = 256 and beyond.

Butler developed an algorithm using a flawed isomorphic rule based on the moments of the designs (word length pattern) that starts with a basic set of factors and then adds one generator at a time to construct new designs. He describes his approach as follows:

"The iterative algorithm uses all the designs with distinct wordlength patterns (or equivalently, distinct T moments) for k factors and adds an extra factor to each to form designs for k+1 factors. Only designs with distinct wordlength patterns are retained for the next stage of the algorithm. At each stage, the wordlength pattern is determined from the elements of T. The algorithm does not recognize that on rare occasions designs with the same wordlength pattern are not necessarily isomorphic. However, a design for k factors can be formed from any of the k projections involving k-1 factors and so designs are highly unlikely to be lost altogether." (Butler 2002b)

Using Butler's methodology, we were able to easily search for even/odd resolution IV designs using Matlab version 6.5 on a Pentium III and IV computer.

Our program constructed a full factorial in seven basic factors for n = 128 runs and then constructed a generator matrix of all possible generators (based on the 120 different interactions involving the basic columns). We then started with the seven basic factors and added one generator at a time. We calculated  $t^D$  for each design and retained only one design for each distinct  $t^D$  vector. This method does not distinguish between non-isomorphic designs with identical design moments (word length patterns). In our implementation, this method was successful in finding all minimum aberration designs except at k = 24, where we found only the weak minimum aberration design. In general,

we lost about two percent of the word length patterns using this approach at n = 128 runs (see Table 10.1). However, we only identified 20% of the even/odd designs that exist. Thus having non-isomorphic designs with the same wlp is a very common occurrence at n = 128. For example, the word length pattern (0, 0, 0, 8, 34, 42, ...) at k = 15, occurs for four designs (see p. 106). Another word length pattern (0, 0, 0, 21, 0, 80, ...) at k = 15, occurs for 48 non-isomorphic designs.

#### 10. An Improved Imperfect Isomorphic Rule Approach

In an effort to find a more discriminating function than  $t^D$  (or equivalently, wlp) for our imperfect isomorphic rule approach to determining isomorphic designs, we turned to the  $G(T2^D)$  vector.  $G(T2^D)$  uniquely determined the same designs cataloged by Sun (2001) and CSW (1993) for n = 128 and k = 8, 9, 10, 11 as well as all designs at n = 64. Although we know that several non-isomorphic designs do have identical  $G(T2^D)$  sets, this happened in only rare instances (see Table 10.1). This means that only those designs with unique  $G(T2^D)$  vectors are kept as we sequentially build up our designs. While this method does miss some designs, the  $G(T2^D)$  vector is much more discriminating than  $t^D$ .

The empirical results at n = 128 show that the designs that were lost were not the better designs in terms of word length pattern, and that although a few (57) non-isomorphic designs were missed, other designs with identical word length pattern, alias length pattern, and number of clear two-factor interaction effects were found.

Table 10.1 lists the number of even/odd designs found using several different isomorphic checks for n=128 and  $k \le 40$ . We show the number of even/odd designs found using the word length pattern as a simple but flawed isomorphic rule, and the number of even/odd designs found using  $G(T2^D)$  as a flawed isomorphic rule. We also show the complete enumeration of all even/odd designs and the number of unique word length patterns that exist among the exhaustive list obtained based on delete-one-factor projections. We also provide percentages of designs found using the different

		parison of Met			n/Odd Res	olution IV	
k	# of e/o	# of unique	t <sup>D</sup>	% found	% found	$G(T2^{D})$ ,	% found
	designs by	e/o wlp by	# of e/o	of e/o	of total	# of e/o	of total
	projections	projections	designs	unique	e/o	designs	e/o
			found	wlp	designs	found	designs
8	2	2	2	100	100	2	100
9	7	7	7	100	100	7	100
10	19	18	18	100	94.7	19	100
11	62	48	48	100	77.4	62	100
12	180	118	118	100	65.6	180	100
13	487	243	243	100	49.9	487	100
14	1,240	448	444	99.1	35.8	1,240	100
15	2,926	777	765	98.5	26.1	2,925	99.9
16	6,208	1,278	1,257	98.4	20.2	6,208	100
17	11,787	1,996	1,946	97.5	16.5	11,787	100
18	19,466	2,890	2,825	97.8	14.5	19,466	100
19	27,994	4,051	3,937	97.2	14.1	27,993	99.9
20	35,192	5,211	5,109	98	14.5	35,192	100
21	39,201	6,237	6,086	97.6	15.5	39,201	100
22	38,847	6,546	6,422	98.1	16.5	38,847	100
23	34,868	6,361	6,226	97.9	17.8	34,868	100
24	28,133	5,656	5,578	98.6	19.8	28,133	100
25	20,569	4,709	4,629	98.3	22.5	20,569	100
26	13,498	3,575	3,516	98.4	26.0	13,498	100
27	8,075	2,611	2,547	97.5	31.5	8,075	100
28	4,284	1,720	1,691	98.3	39.5	4,284	100
29	2,149	1,119	1,099	98.2	51.1	2,149	100
30	976	632	620	98.1	63.5	976	100
31	433	340	332	97.6	76.7	433	100
32	197	177	175	98.9	88.8	197	100
33	101	90	90	100	89.1	101	100
34	31	30	30	100	96.8	31	100
35	13	13	13	100	100	13	100
36	8	8	8	100	100	8	100
37	3	3	3	100	100	3 2	100
38	2	2	2	100	100		100
39	1	1	1	100	100	1	100
40	1	1	1	100	100	1	100

approaches. In no cases did the sets of delete-one-factor projections fail to distinguish designs with different  $t^D$  or  $G(T2^D)$ .

#### 11. Interesting Designs of Size 128

While letter pattern and  $G(T2^D)$  are more discriminating than wlp, neither is universally more successful. For example, at k = 11 we found non-isomorphic designs with distinct  $G(T2^D)$  values and identical letter pattern matrices, while at k = 15 we found non-isomorphic designs with identical  $G(T2^D)$  (and identical bivariate distributions) but distinct letter pattern matrices.

During the exhaustive search for designs, a number of interesting designs were encountered in trying to determine non-isomorphic designs. We describe four problem cases of interest. Below is a sample of some of the designs encountered along with a short description of the designs and their properties.

#### Problem Case 1:

The first case occurs at k = 11. Let pc11a, pc11b, and pc11c represent the three problem designs. All three even/odd designs have the same word length pattern and the same alias length pattern. The first design, pc11a, has a different letter pattern matrix than pc11b and pc11c. The other two designs, pc11b and pc11c, have identical letter pattern matrices. All three designs have unique  $G(T2^D)$  values. Table 11.1 lists the generators for these designs.

**Table 11.1:** k = 11, n = 128 **Problem Designs** 

Design	Generators	
pc11a	7 25 43 116	
pc11b	7 45 56 91	
pc11c	7 56 77 91	

#### Problem Case 2:

The second case occurs at k = 15. These even/odd designs have identical  $G(T2^D)$  values, identical word length patterns, and identical alias length patterns. However, the letter pattern matrix for each design is different. Table 11.2 lists the generators for these designs.

#### Problem Case 3:

The third case occurs at k = 16. There are 18 pairs of designs that have various  $G(T2^D)$  values. Each pair of designs also have identical word length patterns and identical letter pattern matrices respectively. The designs do have different alias length patterns. The first four designs listed below are even/odd designs (a1 through b2) and the remaining designs are even. Table 11.3 lists the generators for these designs.

Table 11.2: k = 15, n = 128 Problem Designs

Design	Generators	
pc15a	7 11 19 38 59 73 100 120	
pc15b	7 11 19 38 62 73 97 120	

Table 11.3: k = 16, n = 128 Problem Designs

_	Dosian				- 120	3110	bien	Desi	gns	
	Design			ators					40:	
-	oc16a1	7	11	19	41	52	61	74		120
-	oc16a2	7	11	19	35	61	62	73	85	120
	oc16b1	7	11	21	38	57	73	82	93	120
-	oc16b2	7	11	19	38	57	73	84	93	120
_	oc16c1	7	11	21	26	31	112	121	122	124
-	oc16c2	7	11	21	25	31	112	121	122	124
_	oc16d1	7	25	42	55	79	112	121	122	124
_	oc16d2	7	25	31	42	52	112	121	122	124
ŗ	oc16e1	7	11	21	26	52	84	121	122	124
Ţ	oc16e2	7	25	26	47	79	112	121	122	124
I	c16f1	7	13	21	104	110	112	118	121	122
ŗ	c16f2	7	11	13	19	100	103	121	122	124
Ţ	c16g1	7	13	28	35	62	104	112	121	122
-	c16g2	7	19	28	41		112	121	122	124
-	oc16h1	7	13	28	38		104	112	121	122
-	c16h2	7	19	31	41		112	121	122	124
_	c16i1	7	13	38	61		104	112	121	122
-	c16i2	7	13	22	38		104	112	121	122
_	c16j1	7	13	44	55		110	112	121	122
_	c16j2	7	13	38	59	61	104	112	121	122
	c16k1	7	13	44	79		110	112	121	122
_	c16k2	7	13	38	59	91	104	112	121	122
_	c1611	7	38	61	69	94	104	112	121	122
_	c16l2	7	13	22	59	91	104	112	121	122
_	c16m1	7	13	22	44	49	62	112	121	122
-	c16m2	7	13	44	59	91	104	112	121	122
-	c16n1	7	13	22	44	49	82	112	121	122
-	c16n2	7	13	44	55	59	104	112	121	122
-	c16o1	7	19	28	35	61	76	112	121	122
_	c16o2	7	28	38	47	61	104	112	121	122
_	c16p1	7	21	25	47	55	84	112	121	122
	c16p2	7	28	38	47	59	104	112	121	122
	c16q1	7	11	19	38	44	52	100	121	122
	c16q2	7	13	21	38	59	104	112	121	122
	c16r1	7	11	19	38	44	100	103	121	122
	c16r2	7	13	21	59	91	104	112	121	122
				~ 1	<i></i>	/1	107	112	141	144

## Problem Case 4:

The fourth case occurs at k = 19. The following two pairs of designs have identical  $G(T2^D)$  values, word length pattern, alias length pattern, and letter pattern matrices respectively. They are only distinguished by their sets of delete-one-factor projections. The first pair (pc19a1 and pc19a2) are even designs, the second pair are even/odd designs. Table 11.4 lists the generators for these designs.

**Table 11.4:** k = 19, n = 128 **Problem Designs** 

1 abic 11			,	_									
Design													
pc19a1	7	13	22	44	49	62	91	98	112	118	121	122	
pc19a2	7	13	22	44	49	62	91	98	112	121	122	124	
pc19b1	7	11	25	31	35	50	85	104	112	121	122	124	
pc19b2_	7	11	25	31	35	50	86	104	112	121	122	124	

# 12. Finding Good Designs Using Naïve Projections

As noted previously, the difficulty of finding minimum aberration designs (and other good designs) increases as n becomes larger. Examining the case of n = 64 suggests that sequentially eliminating factors to minimize the number of length four words in the resulting design (ties broken by the minimization of length-five words, then length-six words, etc.) from a relatively few sos designs present a few design arrays from which good (minimum aberration) designs are found. This method will be referred to as the naïve projection approach.

Table 12.1 lists the number of length-four words ( $w_4$ ) for minimum aberration designs and for the naïve projections from each of the eight even/odd sos designs for n = 64. The naïve projections that result in the minimum aberration design are marked with "\*", while those projections resulting in a weak minimum aberration design are marked with "\*\*".

Table 12.1: Number of Length-Four Words for SOS Naïve Projections, n = 64

sos	sos17j	sos17g	sos17e	sos17d	sos17b	sos18	sos20	MA	k
					-		125*	125	20
							100*	100	19
						92	78*	78	18
	105	73	68	65	60	68	59*	59	17
	77	53	49	45	45	49	43*	43	16
	55	37	33	33	33	34	30*	30	15
	38	24	23	23	23	22**	22*	22	14
14*	25	16	15	15	15	14*	15	14	13
6*	15	10	10	10	10	8	9	6	12
4*	9	5	6	6	6	4*	5	4	11
2*	5	3	3	3	3	2*	2*	2	10
1*	2	1*	1*	1*	1*	1*	1*	1	9
0*	0*	0*	0*	0*	0*	0*	0*	0,2	8

<sup>\* =</sup> minimum aberration; \*\* = weak minimum aberration

It is interesting to note that the 20-factor sos design projects to the minimum aberration design for k = 14, 15, ..., 20 (and also 8, 9, and 10); the 13-factor sos design is weak minimum aberration at k = 13, and its naïve projections are minimum aberration for k = 8, 9, ..., 12. The weak minimum aberration sos design at k = 13 has 36 clear two-factor interactions, 16 more than the minimum aberration design and is arguably preferred over the minimum aberration design due to the more clear two-factor interactions.

Since sequential projection from just two n = 64 run designs provide attractive designs for all k = 8, 9, ..., 20, we list these two sos designs in Table 12.2, arranging the design columns so that one only needs to include the number of generators that correspond to the desired number of factors. For instance, for the minimum aberration 18-factor design, simply omit the last two columns of the 20-factor design. The 20-14.a sos design is recommended for k = 14, ..., 20 and the 13-7.b design for k = 8, ..., 13. These designs and their embedded projections are the minimum aberration or most preferred designs available for every  $k \in [8,20]$ . Figures 12.1 and 12.2 show the aliasing of two-factor interactions for these two sos designs, with generators as specified in Table 12.2. By arranging into columns the interactions in these tables, we conveniently and compactly present the aliasing for each of the embedded designs. These tables enable a practitioner to visualize the additional confusion regarding two-factor interactions that result from adding, e.g., two or three more factors to a 10-factor design.

SOS designs represent a small fraction of all possible resolution IV designs and yet they project to all remaining resolution IV designs. Thus from this subset one can project to all minimum aberration and other good designs. Complete enumeration of

Table 12.2: Generators for SOS Embedded Projection Designs of Size 64

Design	Gen	erators	s for F	actors	s <b>7-20</b>	(ident	ified	by Ya	tes co	umn	numb	er)		
20-14.a	31	39	43	61	49	54	13	21	14	19	25	28	44	58
13-7.b														

Design 13-7.b Generators (Yates column number)

		31	39	43	61	51	62	28		
Singu	ularity Do	etails (A	ll intera	ctions r	ot listed	are cle	ar for c	lesigns wit	th k≤13)	
k:		7	8	9	10	11	12	13		
			3*8 =	4*9 =		5*11				
		6 <b>*</b> 7 =			2*10=		1*12			
			4*8 =	3*9 =				11*13		
	3*4 =			<b>8*</b> 9 =				5*13		
		2*7 =			6 <b>*</b> 10 =			1*13		
	2*6=				7*10 =			12*13		
			5*8 =			3*11 =	:	9*13		
				5*9=		4*11 =	:	8*13		
	3 <b>*</b> 5 =					8*11 =	:	4*13		
	4*5 =					9*11 =	:	3*13		
					1*10 =		2*12 =	e 6*13		
		1*7=					6*12 =	= 2*13		
	1*6=						7*12 =	10*13		
	1*2 =						10*12	= 7*13		

Figure 12.1: Design 13-7.b Generators and Aliasing for Embedded Projections

Design 20-14.a Generators (Yates column number)

1*9 = 8*13 =     12*18 =       5*8 = 1*12 =     9*18 =       5*9 = 12*13 =     8*18 =       3*8 = 4*9 =     12*14 =       4*12 =     9*14 =       3*9 = 4*8 =     12*17 =       7*8 =     12*15 =       7*9 = 2*12 =     8*16 =       2*8 =     9*15 = 12*16 =       2*9 = 7*12 =     8*15 =       9*10 = 8*11 = 6*12 =     15       1*8 = 5*12 = 9*13 =     15	2*20 2*20 0*20 1*20 5*20 5*20 3*20 1*20 7*20 3*20 1*20
1*5 = 6*11 = 8*12 =     3*14 =     7*15 =     2*16 =     4*17 =     13*18 =     10*19 =     5       2*7 = 6*10 = 9*12 = 5*13 =     4*14 =     15*16 =     3*17 =     1*18 =     11*19 =     8       3*4 = 8*9 = 10*11 = 1*13 =     2*15 =     7*16 =     14*17 =     5*18 =     6*19 =     12*18 =     11*19 =     8       6*8 = 11*12 =     2*15 =     7*16 =     14*17 =     5*18 =     6*19 =     12*19 =     12*19 =	2*20 2*20 0*20 1*20 5*20 5*20 3*20 1*20 7*20 3*20 1*20
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	2*20 0*20 1*20 5*20 5*20 3*20 1*20 7*20 3*20 1*20
6*8 = 11*12 =	0*20 1*20 5*20 5*20 3*20 1*20 7*20 3*20 4*20
6*8 = 11*12 = 6*9 = 10*12 = 8*10 = 9*11 = 12*19 = 6*10 = 12*19 = 6*10 = 12*19 = 6*10 = 12*19 = 6*10 = 12*19 = 6*10 = 12*19 = 6*10 = 12*19 = 6*10 = 12*19 = 6*10 = 12*19 = 6*10 = 12*19 = 6*10 = 12*19 = 6*10 = 12*19 = 6*10 = 12*19 = 6*10 = 12*19 = 6*10 = 12*19 = 6*10 = 12*19 = 6*10 = 12*19 = 6*10 = 12*10 = 10*10 = 11*10 = 11*13 = 6*15 = 10*16 = 10*19	1*20 5*20 5*20 3*20 1*20 7*20 3*20 4*20
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	5*20 5*20 3*20 1*20 7*20 3*20 4*20
8*10 = 9*11 =     12*19 =       1*9 = 8*13 =     12*18 =       5*8 = 1*12 =     9*18 =       5*9 = 12*13 =     8*18 =       3*8 = 4*9 =     12*14 =       4*12 =     9*14 =       3*9 = 4*8 =     12*17 =       7*8 =     12*15 =       7*9 = 2*12 =     8*16 =       2*8 =     9*15 =       2*9 = 7*12 =     8*15 =       9*10 = 8*11 = 6*12 =     1**14 =       1*8 = 5*12 = 9*13 =     1**14 =       3*12 =     8*14 =       3*6 =     11*14 =       3*10 = 4*11 =     6*17 =       4*6 =     10*14 =       4*10 = 3*11 =     6*14 =       7*11 =     6*15 =       10*18 =     13*19       6*15 =     10*18 =       10*18 =     13*19       6*18 =     5*19       5*10 = 6*13 =     11*18 =       5*6 = 1*11 =     10*13 =	5*20 3*20 1*20 7*20 3*20 4*20
1*9 = 8*13 =     12*18 =     3*8 =     12*18 =     3*8 =     12*18 =     3*8 =     12*18 =	3*20 1*20 7*20 3*20 4*20
5*8 = 1*12 =         9*18 =         12*14 =           5*9 = 12*13 =         12*14 =         12*17 =           3*8 = 4*9 =         12*14 =         12*17 =           4*12 =         9*14 =         8*17 =           3*9 = 4*8 =         12*15 = 9*16 =         12*17 =           7*8 =         12*15 = 9*16 =         12*16 =           2*8 =         9*15 = 12*16 =         12*18 =           2*9 = 7*12 =         8*15 =         16*12 =           9*10 = 8*11 = 6*12 =         18*14 =         18*15 =           13*12 =         8*14 =         9*17 =         18*15 =           3*10 = 4*11 =         6*17 =         14*19 =         14*19 =           4*10 = 3*11 =         6*14 =         11*17 =         3*19 =           4*10 = 3*11 =         6*14 =         10*18 =         13*19 =           1*6 = 5*11 =         6*15 = 10*16 =         10*18 =         13*19 =           1*10 = 11*13 =         6*18 =         5*19 =         11*18 =         11*19 =           5*6 = 1*11 = 10*13 =         18*19         11*18 =         11*19 =	1*20 7*20 3*20 4*20
5*9 = 12*13 =     3*8 = 4*9 =     12*14 =     12*17 =     12*	7*20 3*20 4*20
3*8 = 4*9 =     12*14 =     9*14 =     8*17 =     12*17 = <td>3*20 4*20</td>	3*20 4*20
4*12 =     9*14 =     8*17 =       3*9 = 4*8 =     12*15 =     9*16 =       7*8 =     12*15 =     9*16 =       7*9 = 2*12 =     8*16 =     12*17 =       2*8 =     9*15 =     12*16 =       2*9 = 7*12 =     8*15 =     16       9*10 = 8*11 = 6*12 =     18*15 =     16*17 =       1*8 = 5*12 = 9*13 =     18*14 =     9*17 =       3*12 =     8*14 =     9*17 =       3*6 =     11*14 =     10*17 =     4*19       3*10 = 4*11 =     6*17 =     14*19       4*6 =     10*14 =     11*17 =     3*19       4*10 =     3*11 =     6*14 =     17*19       7*11 =     6*15 =     10*16 =     2*19       1*6 = 5*11 =     10*18 =     13*19       1*10 =     11*18 =     5*19       5*10 = 6*13 =     11*18 =     1*19       5*6 = 1*11 =     10*13 =     18*19	<b>1*20</b>
3*9 = 4*8 =     12*17 =     12*17 =       7*8 =     12*15 = 9*16 =     2       7*9 = 2*12 =     8*16 =     1       2*8 =     9*15 = 12*16 =     1       2*9 = 7*12 =     8*15 =     16       9*10 = 8*11 = 6*12 =     15     1       1*8 = 5*12 = 9*13 =     1     1       3*12 =     8*14 =     9*17 =     2       3*6 =     11*14 =     10*17 =     4*19       3*10 = 4*11 =     6*17 =     14*19       4*6 =     10*14 =     11*17 =     3*19       4*10 = 3*11 =     6*14 =     17*19       7*11 =     6*15 = 10*16 =     2*19       1*6 = 5*11 =     10*18 =     13*19       1*10 = 11*13 =     6*18 =     5*19       5*10 = 6*13 =     11*18 =     11*19       5*6 = 1*11 = 10*13 =     18*19	<b>1*20</b>
7*8 = 12*15 = 9*16 = 2*8 = 9*15 = 12*16 = 2*9 = 7*12 = 8*15 = 9*15 = 12*16 = 2*9 = 7*12 = 8*15 = 9*17 = 15*12 = 15*12 = 15*13 = 15*12 = 15*13 = 15*13 = 15*13 = 15*13 = 15*13 = 15*13 = 15*13 = 15*6 = 1*11 = 10*13 = 15*13 = 15*6 = 1*11 = 10*13 = 15*15 = 10*15 = 10*16 = 10*17 = 2*19	
7*9 = 2*12 = $2*8 =$ $9*15 = 12*16 =$ $2*9 = 7*12 =$ $9*10 = 8*11 = 6*12 =$ $18* = 5*12 = 9*13 =$ $3*12 =$ $3*6 =$ $3*10 = 4*11 =$ $4*6 =$ $4*10 = 3*11 =$ $7*11 =$ $10*14 =$ $10*17 =$ $4*19$ $4*10 = 3*11 =$ $10*14 =$ $10*17 =$ $10*17 =$ $14*19$ $11*17 =$ $10*14 =$ $11*17 =$ $11*17 =$ $11*17 =$ $11*17 =$ $11*17 =$ $11*18 =$ $11*18 =$ $11*18 =$ $11*18 =$ $11*19$ $11*18 =$ $11*19$	2*20
2*8 =       9*15 = 12*16 =         2*9 = 7*12 =       8*15 =         9*10 = 8*11 = 6*12 =       16         1*8 = 5*12 = 9*13 =       17         3*12 =       8*14 =       9*17 =         3*6 =       11*14 =       10*17 =       4*19         4*6 =       10*14 =       11*17 =       3*19         4*10 = 3*11 =       6*14 =       17*19         7*11 =       6*15 = 10*16 =       2*19         1*6 = 5*11 =       10*18 =       13*19         5*10 = 6*13 =       6*18 =       5*19         5*6 = 1*11 = 10*13 =       18*19	5*20
2*9 = 7*12 = 8*15 = 16  9*10 = 8*11 = 6*12 = 15  1*8 = 5*12 = 9*13 = 16  3*12 = 8*14 = 9*17 = 4*19  3*10 = 4*11 = 6*17 = 14*19  4*6 = 10*14 = 11*17 = 3*19  4*10 = 3*11 = 6*14 = 17*19  7*11 = 6*15 = 10*16 = 2*19  1*6 = 5*11 = 10*13 = 10*18 = 13*19  5*6 = 1*11 = 10*13 = 18*19	7*20
9*10 = 8*11 = 6*12 = $1*8 = 5*12 = 9*13 =$ $3*12 =$ $3*6 =$ $11*14 =$ $10*17 =$ $4*19$ $4*10 = 3*11 =$ $4*10 = 3*11 =$ $10*14 =$ $10*14 =$ $11*17 =$ $10*14 =$ $11*17 =$ $11*19$ $11*19$ $1*10 = 11*13 =$ $10*18 =$ $11*19$ $11*18 =$ $11*19$ $11*19 =$ $11*1$	5*20
1*8 = 5*12 = 9*13 =     3*12 =     8*14 =     9*17 =       3*6 =     11*14 =     10*17 =     4*19       3*10 = 4*11 =     6*17 =     14*19       4*6 =     10*14 =     11*17 =     3*19       4*10 = 3*11 =     6*14 =     17*19       7*11 =     6*15 = 10*16 =     2*19       1*6 = 5*11 =     10*18 =     13*19       5*10 = 6*13 =     6*18 =     5*19       5*6 = 1*11 = 10*13 =     18*19	9*20
3*12 =     8*14 =     9*17 =       3*6 =     11*14 =     10*17 =     4*19       3*10 = 4*11 =     6*17 =     14*19       4*6 =     10*14 =     11*17 =     3*19       4*10 = 3*11 =     6*14 =     17*19       7*11 =     6*15 =     10*16 =     2*19       1*6 = 5*11 =     10*18 =     13*19       5*10 = 6*13 =     6*18 =     5*19       5*6 = 1*11 = 10*13 =     18*19	8*20
3*6 =     11*14 =     10*17 =     4*19       3*10 = 4*11 =     6*17 =     14*19       4*6 =     10*14 =     11*17 =     3*19       4*10 = 3*11 =     6*14 =     17*19       7*11 =     6*15 = 10*16 =     2*19       1*6 = 5*11 =     10*18 =     13*19       1*10 = 11*13 =     6*18 =     5*19       5*10 = 6*13 =     11*18 =     1*19       5*6 = 1*11 = 10*13 =     18*19	4*20
3*10 = 4*11 = $4*6 =$ $4*10 = 3*11 =$ $7*11 =$ $10*14 =$ $10*14 =$ $11*17 =$ $11*17 =$ $17*19$ $1*6 = 5*11 =$ $1*10 = 11*13 =$ $10*18 =$ $10*18 =$ $10*18 =$ $10*18 =$ $10*18 =$ $10*18 =$ $10*18 =$ $11*19$ $10*18 =$ $11*19$ $11*18 =$ $11*19$ $11*19$	
4*6 = $4*10 = 3*11 =$ $7*11 =$ $10*14 =$ $11*17 =$ $17*19$ $1*19 =$ $1*6 = 5*11 =$ $1*10 = 11*13 =$ $10*18 =$ $10*18 =$ $10*18 =$ $10*18 =$ $10*18 =$ $10*18 =$ $10*18 =$ $11*19 =$ $10*18 =$ $11*19 =$ $11$	
4*10 = 3*11 =     6*14 =     17*19       7*11 =     6*15 = 10*16 =     2*19       1*6 = 5*11 =     10*18 = 13*19       1*10 = 11*13 =     6*18 = 5*19       5*10 = 6*13 =     11*18 = 1*19       5*6 = 1*11 = 10*13 =     18*19	
7*11 = 6*15 = 10*16 = 2*19 1*6 = 5*11 = 10*18 = 13*19 1*10 = 11*13 = 6*18 = 5*19 5*10 = 6*13 = 11*18 = 1*19 5*6 = 1*11 = 10*13 = 18*19	
1*6 = 5*11 =       10*18 =       13*19         1*10 = 11*13 =       6*18 =       5*19         5*10 = 6*13 =       11*18 =       1*19         5*6 = 1*11 = 10*13 =       18*19	
1*10 = 11*13= 6*18 = 5*19 5*10 = 6*13 = 11*18 = 1*19 5*6 = 1*11 = 10*13 = 18*19	
5*10 = 6*13 = 11*18 = 1*19 5*6 = 1*11 = 10*13 = 18*19	
5*6 = 1*11 = 10*13 = 18*19	
6*7 = 2*10 = 11*15 = 16*19	
2*11 = 10*15 = 6*16 = 7*19	
1*2 = 13*15 = 5*16 = 7*18	
1*7 = 5*15 = 13*16 = 2*18	
1*3 = 4*13 = 5*14 = 17*18	
1*4 = 3*13 = 5*17 = 14*18	
3*5 = 1*14 = 13*17 = 4*18	
4*5 = 13*14 = 1*17 = 3*18	
5*7 = 2*13 = 1*15 = 16*18	
2*5 = 7*13 = 1*16 = 15*18	
3*7 = 14*15 = 4*16 = 2*17	
2*3 = 4*15 = 14*16 = 7*17	
2*4 = 7*14 = 3*15 = 16*17	
4*7 = 2*14 = 3*16 = 15*17	

Figure 12.2: Design 20-14.a Generators and Aliasing for Embedded Projections

these projections is prohibitive for large n. However, we have found that naïve projections from sos designs at n = 64 and n = 128 identify the best resolution IV designs.

It is known from projective geometry that for n = 16, 32, 64, ..., sos designs exist at k = n/4 + 1 (Cheng 2002). Furthermore any sos design D with k factors, and n runs can be doubled by the construction method  $\begin{bmatrix} D & D \\ D & -D \end{bmatrix}$  to produce a sos design of size 2k factors and 2n runs (Cheng 2002). For k > n/4 + 1, all sos designs are doubled sos designs. To construct sos designs for k = n/4 + 1, see Cheng (2003). Unfortunately, these designs only represent a small fraction of the total sos designs that exist for any given n.

Complementing Cheng's theoretical results, we have determined for n = 128 that there exist 88 resolution IV sos designs, 50 with  $k \ge n/4 + 1$ , and 38 with k < n/4. Figure 12.3 summarizes these findings. Naïve projections of these sos designs lead to minimum aberration designs. Table 12.3 lists the length four words resulting from the naïve projections for k = 24, 22, and 21 sos designs. Table 12.4 lists the naïve projections for the k = 25 sos designs. Table 12.5 lists the naïve projections for k = 29, 28, 27, and 26 sos designs. Table 12.6 lists the naïve projections for the top ten sos designs at k = 33. Table 12.7 lists the naïve projections for k = 40, 36, 34, and 31 sos designs.

We have found 88 sos designs at 14 different values of k at n = 128. Four of these sos designs are the minimum aberration design; this occurs at k = 25, 29, 40, and 64. It is interesting to note that even some of the less desirable (in terms of wlp) sos designs often project to minimum aberration designs and other good designs. For instance, at k = 28, the sos design 28-21.1157 (ranked number 1157 in terms of wlp) naively projects to the

n=8	n = 16	n = 32	n = 64	n = 128	k/n
k=4	k=8	k = 16	k = 32	k = 64	1/2
	$k = 5_{\text{(res. V)}}$	k = 10	k = 20	k = 40	5/16
		k = 9	k = 18	k = 36	9/32
			$k = 17_{(5 \text{ types})}$	$k = 34_{(5 \text{ types})}$	17/64
				$k = 33_{(42 \text{ types})}$	33/128
Note: All	l sos designs				65/256
	dashed line are				
even/odd	designs.			k=31	
				k=29	
				k=28	
				k = 27	
			k = 13	k = 26 38 des	signs
				k=25	
	T.			k=24	
				k=22	
				k=21	

Figure 12.3: Existence of SOS Designs

Table 12.3:  $k = 24, 22, \text{ and } 21 \text{ SOS Designs Naïve Projections Length-4 Words } (w_4,...), n = 128$ 

	THE PARTY OF THE		and dead will be not been	-	Bus that to Jeenous Dengin-4 words (wa	Table 1	STORE STORE		us ( 44).	.), " - 1.	9			
ᅩ	MA	sos24a	sos24b	sos24c	sos24d	sos24e	sos24f	sos22a	sos22b	sos21a	sos21b	sos21c	sos21d	sos21e
24	102	103	104	109	111	115	115							
23	83	84	85	88	88	92	92							
22	9	89	89	70	89	72	72	69	85					
21	51	53	54	53	52	58	99	53	99	52	26	64	80	112
20	36	41	41	41	38	44	42	41	20	40	4	48	09	80
19	27	30	30	31	28	33	30	30	37	30	34	36	44	58
18	20	22	22	23	<b>50</b> **	23	21	23	27	23	25	27	31	41
17	15	15**	15**	16	15**	17	15**	17	18	17	19	19	21	28
16	10	11	11	11	11	12	11	12	12	12	13	12	13	18
15	7	<b>**</b> /	**/	<b>**</b>	*/	<b>∞</b>	*/	<b>∞</b>	<b>∞</b>	<b>∞</b>	<b>∞</b>	<b>∞</b>	<b>∞</b>	12
14	cc	4	4	4	3*	2	3*	2	4	2	5	2	4	<b>∞</b>
13	7	7*	<b>5</b> *	<b>5</b> *	2**	3	<b>5</b> **	n	<b>5</b> *	Э	2*	<b>5</b> *	2*	2
12	_	*	*	**	*	*	**	*	1**	**	*	*	**	3
11	9,0	*0	*0	*0	*0	*0	*0	*0	*0	*0	*0	*0	*0	1
10	0,3	*0	*0	*0	*0	*0	*0	*0	*0	*0	*0	*0	*0	*0
6	0,0,3	*0	*0	*0	*0	*0	*0	*0	*0	*0	*0	*0	*0	*0

155 119 93 76 60 60 47 47 35 26 118 118 sos25k 155 119 sos25j sos25i 119 93 75 59 44 44 32 23 16 Table 12.4: k = 25 SOS Designs Naïve Projections Length-4 Words (w<sub>4</sub>,...), n = 128sos25h \* 4 \*7 147 115 89 89 69 54 41 31 23 \* 11 sos25g \* 4 \* \* 146 115 89 89 72 57 57 83 33 18 18 sos25f sos25e 143 111 85 65\* 52 40 30 22 16 sos25d 89 70 53 40 28 20\*\* 11 11 7\* 3\* 3\* 0\* 0\* 114 sos25c 83\* 65\*\* 51\* 40 30 23 117 112 8 8 8 5 5 0\* 0\* 107 sos25b 86 68 54 41 31 11 11 11 7\*\* 7\*\* 0\* 125 105 sos25a 102\*\* 51\*\*
39
30
22
22
15\*\*
11
7\*\*
4
4
4
0\* 124\* 83\*\* 124 102 83 83 83 83 51 51 10 7 7 7 7 k 25 24 24 22 22 22 20 11 11 11 11 11 11 11 11 11 11 14 13 11 11

47 35 25 16 11 11 7\*\*

sos25m

Table 12.5: k = 29, 28, 27, and 26 SOS Designs Naïve Projections Length-4 Words (w4,...), n = 128

490000	303700			190	146	114	95	77	62	48	37	27	20	14	6	S	ю	*	*0	*0	*0
090303	303204			181	143	113	91	70	54	39	30	22	16	11	**/	4	*	*	*0	*0	*0
67.C303	3037/4		234	190	153	122	96	9/	59	44	33	24	17	12	<b>∞</b>	2	<b>5</b> *	*	*0	*0	*0
n = 1	30357		210	176	145	117	92	73	57	45	34	24	18	12	<b>∞</b>	2	3	*	*0	*0	*0
coc 38 $coc 37a$ $coc 37b$ $coc 37c$	2027 0		207	163	133	105	98	89	53	41	30	22	16	11	<b>**</b> /	4	*	**	*0	*0	*0
coc77a	2027/4		202	168	137	111	88	70	54	42	32	24	17	11	1**	4	*	*	*0	*0	*0
socions social	20250	290	237	191	153	121	94	71	52	36*	27*	50**	15**	11	*/	3*	<b>5</b> **	*	*0	*0	*0
ene 79c	370	308	254	207	167	135	107	83	63	48	35	25	17	11	<b>**</b> /	4	*	*	*0	*0	*0
soc 29h	306	250	208	173	141	114	6	71	99	43	32	23	15**	=	*/	3*	<b>5</b> **	**	*0	*0	*0
s0529a	266*	210*	180*	152*	126	102*	82	69	99	44	34	25	17	10*	**/	4	<b>*</b> 2	*	*0	*0	*0
k MA sos 99 sos 90h sos 90c	266	210	180	152	124	102	83	65	51	36	27	20	15	10	7	3	7	1	9,0	0,3	6,0,3
k	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	6

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6: Top Ten $k=3$
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Table 12
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		Plus	32	more																					
sos33j	605	521	445	376	318	592	220	182	149	120	26	9/	59	46	34	25	18	12	∞	2	<b>5</b> **	*	*0	*0	*0
sos33i	605	525	455	392	334	285	240	200	165	137	112	90	71	99	43	32	23	15	11	7	n	7	-	*0	*0
sos33h	909	521	453	392	334	285	239	200	165	137	112	06	72	99	43	32	23	15	11	7	n	7		*0	*
sos33g	605	525	457	395	338	289	244	205	169	138	110	90	72	57	43	33	24	17	11	7	3	7	-	*0	*0
sos33f	009	521	449	386	330	280	235	198	165	136	110	06	72	57	43	33	24	17	11	7	8	7		*0	*0
sos33e	009	525	455	392	334	285	240	200	165	137	112	06	72	99	43	32	23	15	11	7	8	7	_	*0	*0
sos33d	009	525	453	392	334	285	239	200	165	137	112	06	71	99	43	32	23	15	П	_	ю	2	1	*0	*0
sos33c	597	517	447	386	330	280	235	198	165	136	112	90	71	99	43	32	23	15	11	7	m	7	<del></del>	*0	*0
sos33b	592	509	434	366	308	256	210	174	142	113	91	71	53	42	32	24	18	13	∞	2	*	**	*0	*0	*0
sos33a	592	517	447	386	330	280	235	198	165	136	110	06	72	57	45	34	25	17	111	7	n	2	-	*0	*0
MA	518	452	391	335	266	210	180	152	124	102	83	65	51	36	27	20	15	10	7	т	7		9,0	0.3	0,0,3
×	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	6

Table 12.7: k = 40, 36, 34, and 31 SOS Designs Naïve Projections Length-4 Words  $(w_4,...)$ , n = 128

<u>K</u>	MA	sos40	sos36	sos34a	sos34b	sos34c	sos34d	sos34e	sos31a	sos31b
40	1190	1190*								
39	1071	1071*								
38	959	959*								
37	854	854*								
36	756	756*	889							
35	665	665*	776							
34	589	589*	674	616	656	680	720	976		
33	518	518*	582	540	560	588	624	848		
32	452	452*	499	471	480	503	537	733		
31	391	391*	426	408	417	432	458	630	410	439
30	335	335*	360	350	359	366	391	538	345	371
29	266	289	302	300	306	312	330	456	287	310
28	210	248	254	254	261	262	276	384	238	259
27	180	210	213	214	219	222	231	321	195	213
26	152	175	177	177	183	185	190	265	161	176
25	124	145	145	145	150	154	155	217	130	143
24	102	121	117	116	121	126	126	176	105	117
23	83	99	94	95	96	101	100	140	86	94
22	65	79	73	76	78	81	77	109	68	74
21	51	61	59	59	62	63	61	85	55	56
20	36	45	47	44	47	50	48	64	43	44
19	27	36	36	31	36	38	36	46	32	33
18	20	28	27	20*	26	28	26	34	23	24
17	15	21	20	15*	18	20	19	24	16	17
16	10	15	14	11	11	13	13	16	11	11
15	7	10	10	7*	7*	8	9	11	7**	7**
14	3	6	6	3*	3*	5	6	7	4	4
13	2	4	3	2**	2**	2**	3	4	2*	2*
12	1	2	1**	1**	1**	1**	1**	2	1*	1*
11	0,6	1	0*	0*	0*	0*	0*	1	0*	0*
10	0,3	0*	0*	0*	0*	0*	0*	0*	0*	0*
9	0,0,3	0*	0*	0*	0*	0*	0*	0*	0*	0*

minimum aberration design for k = 20, 19, and 15; and the weak minimum aberration design for k = 18 and 17.

# 13. Preliminary Results for Resolution IV Designs of Size 256

While identifying almost 300,000 even/odd designs at n = 128 was challenging, this pales with the challenge of exhaustively enumerating all designs for n = 256 due to the great number of designs. For example, while only 88 sos designs exist at n = 128, we have found over 34,000 sos designs in random searches at n = 256 (See Table 13.1).

To aid in finding good designs, we implemented a method that combined some of our more successful strategies for finding good designs at n = 64 and n = 128. Our search at n = 256 used two basic approaches. The first approach consists of a random search for sos designs by starting with a design whose columns formed a full factorial and then randomly adding generators to available columns one at a time until an sos design is discovered (stopping if k > 65 since all 50 sos designs in this range are already known). Then from these sos designs, we find good designs from the sos designs by naïve projection. The second approach was to find new designs by sequentially building up a factor at a time using  $t^D$  as a flawed isomorphic rule to check for isomorphism and retaining the top 2,000 designs from each sequential search and building up from those 2,000 designs.

Table 13.1: Number of Regular Resolution IV designs

n	# of even/odd sos designs	# of even/odd designs	# of even designs	# of even sos designs
16	1	1	4	1
32	2	5	20	1
64	8	150	349	1
128	87	≥296,960	$> 10^6$	1
256	> 34,015	?	?	1

For naïve projection from sos designs approach, there are at least three ways to find sos designs:

- Double the sos designs at n = 128
- Random addition of eligible columns until an sos design is found
- Find good designs using software for fixed k and then build up to an sos design

For the sequential buildup technique the issue of which subset of designs to retain at each step is critical. For instance, if only the top 1,000 designs are retained at each buildup step for n=256, then all the designs buildup to sos designs with  $k \le 40$ . Future work will explore this issue.

From Franklin (1984) we know the minimum aberration values for designs with up to k = 17 factors for n = 256. We also know that as early as k = 11, we will lose some designs using  $t^D$  as a flawed isomorphic rule. However, we still find all the known minimum aberration designs. At k = 17, we found 33,142 resolution IV designs with different  $t^D$ . Of those, 32,126 are even/odd designs. The 1,016 even designs will continue to grow in number, approximately doubling at each factor until they reach k = 64. Based upon our results as n = 128, we would expect the number of even/odd designs to increase for each factor until k = 44, and then gradually decline at each factor until k = 80. (See Table 13.2).

Table 13.2: Existence of Regular Resolution IV designs

$\boldsymbol{k}$	# of	# of even	# of	# of even	# of e/o designs	# even designs
	even/odd	designs,	even/odd	designs,	based on	based on
	designs,	n = 64	designs,	n = 128	$t^D/G(T2^D)$	$t^D/_{G(T2^D)}$ ,
	n = 64		n = 128		n = 256	n = 256
7	2	2	-	_	-	-
8	3	4	2	3	-	_
9	6	6	7	6	3/3	3/3
10	12	12	19	14	12 / 12	9/9
11	20	14	62	30	44 / 50	17 / 24
12	22	21	180	69	153 / 231	44 / 80
13	24	23	487	136	536 / 1,188	89 / 241
14	20	29	1,240	295	1,690 / 6,505	176 / 839
15	15	29	2,926	596	4,668 / 54,269	312 / 3,467
16	11	37	6,208	1,292	12,598 / ?	564 / ?
17	10	30	11,787	2,651	32,126 / ?	1,016 / ?
18	3	30	19,466	5,598	?	?
19	1	24	27,994	11,341	$\dot{?}$	?
20	1	23	35,192	22,728	$\dot{?}$	?
21	-	16	39,201	43,516	$\dot{?}$	?
22	-	15	38,847	79,603	?	?
23	-	9	34,868	?	?	?
24	-	8	28,133	?	?	?
25	-	5	20,569	?	?	?
26	-	4	13,498	?	?	?
27	_	2	8,075	?	?	?
28	-	2	4,284	?	?	?
29	-	1	2,149	?	?	?
30	-	1	976	?	?	
31	-	1	433	?	?	? ?
32	-	1	197	?	?	?
33	-	-	101	?	?	?
34	-	-	31	?	?	?
35	-	-	13	?	?	?
36	-	-	8	?	?	?
37	-	-	3	?	?	?
38	-	-	2	?	?	?
39	-	-	1	?	?	?
40	-	-	1	?	?	?

The sheer number of designs that exist at larger n shows the value of the naïve projection method. We are able to rather efficiently evaluate the naïve projections of sos designs at n = 256. Table 13.3 below shows the best designs found (based on wlp) for each respective k, and the corresponding alp, number of degrees of freedom used for main effects and two-factor interactions, the number of clear two-factors, and  $L_{max}$  for each design. The Yates ordered columns for those designs are listed in Table 13.4.

We have found over 34,015 sos designs at n = 256. The sos designs found occur at k = 33, ..., 66, 68, 72, 80, and 128 at n = 256. Future work will involve improving methods of finding good sos designs.

Additional future work will involve looking at ways to refining the naïve projection method to possibly including additional projections. It is no surprise that empirical evidence at n = 128 demonstrated at times the second best (or worse) projection for one design, could eventually lead to a better design a few projections later. Consider the even/odd  $2_{IV}^{40-33}$  design. The naïve projections based on minimizing  $t^D$  lead to a different design at  $t^D = 16$  than if the criteria looked at only minimizing the length-4 and length-5 words with ties broken arbitrarily. The hope would be to find a method to identify which small set of projections lead to good designs. We would want as small a set of projections as possible that lead to good designs to avoid the combinatorial problem of having to look at all possible combinations of projections.

Table 13.3: Characterization of Good Designs for n = 256

alp	36	45	55	99	78	91	105	120	136	135 9	147 12	160 15	162 21 2	168 21 7	136 57 1	120 75 2	108 90 4	94 102 9	80 114 13 1	66 126 16 3	73 99 45	55 105 50 5	21 140 41 6 1 2	19 124 57 9 2 2	17 106 75 13 2 2	15 97 80 21 2 3	9 88 88 28 2 4
Lmax		-	_	-	Ţ	_	_	_	1	7	7	7	3	3	3	m	3	3	4	4	3	4	9	9	9	9	9
C2FI	36	45	55	99	78	91	105	120	136	135	147	160	162	168	136	120	108	94	80	99	73	55	21	19	17	15	6
df	45	55	99	78	91	105	120	136	153	162	178	195	206	218	217	221	227	231	235	239	246	245	242	245	248	252	254
W <sub>6</sub>	0	1	9	12	12	18	30	44	89	114	168	240	268	346	450	582	752	963	1224	1550	1908	2340	2928	3576	4360	5272	6360
Ws																											1488
W4																									•		
×	6	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25 34	26	27	28	59	30	31 1	32 1	33 1	34 1	35 2

dle	81 96 36 0 6	2 50 102 56 0 2 2 1	. 33 104 72 0 2 0 3	21 92 96 0 0 2 3	$0\ 10\ 80\ 120\ 0\ 0\ 5$	10 25 59 56 39 9 6 5 2 1	10 24 56 43 45 16 6 9 2 1	$0\ 22\ 30\ 100\ 27\ 0\ 0\ 23\ 3\ 1\ 0\ 0\ 1$	0 17 21 102 39 0 0 12 14 0 1 0 1	0 16 12 92 59 0 0 6 14 6 0 1 1	) 16 0 84 79 0 0 2 12 10 2 0 2	$0\ 16\ 0\ 52\ 110\ 1\ 0\ 2\ 6\ 12\ 5\ 1\ 0\ 2$	$0\ 16\ 0\ 24\ 132\ 7\ 0\ 2\ 0\ 18\ 0\ 6\ 0\ 0\ 2$	$0\ 0\ 0\ 36\ 119\ 27\ 0\ 5\ 0\ 0\ 0\ 6\ 8\ 3$	$0\ 0\ 0\ 16\ 120\ 46\ 0\ 5\ 0\ 0\ 0\ 0\ 10\ 7$	$0\ 0\ 0\ 0\ 112\ 70\ 0\ 5\ 0\ 0\ 0\ 0\ 17$	$0\ 0\ 0\ 6\ 102\ 32\ 0\ 0\ 48\ 0\ 8\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 1$	000381560002424800000000000000	$0\ 0\ 0\ 1\ 57\ 82\ 0\ 0\ 0\ 8\ 32\ 16\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 1$	24 32 0 0 0 0 0 0 0 0	0000000	00000000000000009	0 0	000000000	000015	00000000112480000000000312
Lmax	9	<b>∞</b>	<b>∞</b>	<b>∞</b>	<b>∞</b>	10	10	13	13	13	13	14	15	15	15	15	24	25	56	27	28	28	53	22	22	23
C2FI	0	7	_	_	0	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
đf	255	252	253	254	255	253	254	250	251	252	253	254	255	253	254	255	249	250	251	252	253	254	255	234	235	236
Table 13.3 (Continued)	6 225 1728	264 2004		39 333 2632 12512	_		3388 2	619 3818	4290	760 4792	5352	926 5980	1019 6648	1154 7383	1257 8200	51 1365 9100 68068	1500 9264	1632	1769		56 2058 13440 129920	• •	58 2534 15120 164304	59 2870 14256 197856	60 3075 15552 219840	61 3307 16848 244344

				3		13	4 11	690						<b>1</b>	$a_{35}=15$	$a_{16}=15$	$a_{37}=15$	a <sub>38</sub> =15	a <sub>39</sub> =15	$a_{40}=15$
	alp	0000000007279900000000000069	000000000000000000000000000000000000000	000000000000000000000000000000000000000	000000000000000000000000000000000000000	$0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0$	00000000187484000000000000000000	00000000007697212000000000000000000000	$0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0$	$0.0000012040 \ a_{30}=10 \ a_{31}=5$	$0.0000072808 \ a_{31}=11 \ a_{32}=4$	$0.000003696271a_{32}=12a_{33}=3$	$0.000001288573$ $a_{33}=13a_{34}=2$	$00000056986$ $a_{34}=14 a_{35}=1$	000000015010	000000000000000000000000000000000000000	00000000459916	00000000159748	000000000000000000000000000000000000000	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 160
		00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000
	Lmax	24	25	26	26	27	28	29	30	31	32	33	34	35	35	36	37	38	39	40
	C2FI Lmax	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	df	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255
Table 13.3 (Continued)	Ws W6	62 3548 18252 270960	19773 299796	21420 330960	23203 364560	24989 401898	26912 442160	28982 485484	69 5567 31210 532008	33612 581862	36014 636851	38586 695799	41343 758875	44296 826252	47460 898100	50625 976808	77 8800 54000 1060766	78 9285 57600 1150184	79 9785 61440 1245272	80 10300 65536 1346240
Table 13,	k W4	62 3548	63 3798	64 4057	65 4325	66 4619 24989	67 4924 26912	68 5240	. 1955 69	70 5905	71 6273		73 7048 4	74 7455 4	75 7875 4	76 8330 5	77 8800 5	78 9285	79 9785 (	80 10300

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42	1 2 4 8 14 16 32 39 42 50 53 57 62 64 67 70 74 76 81 84 87 91 93 128 138 151 157 166 171 177 188 196 199 203 210 216 223 226 233 239 243 244
43	1 2 4 8 11 16 19 22 32 35 38 49 61 62 64 71 90 93 106 109 114 117 120 127 128 131 141 153 154 159 170 175 181 182 187 193 198 200 207 212 227
	250 253
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	227 250 253
45	1 2 4 8 11 16 19 22 32 35 38 49 61 62 64 71 90 93 106 109 114 117 120 127 128 131 141 153 154 159 169 170 175 181 182 187 193 198 200 207 211
	212 227 250 253
46	1 2 4 8 11 16 19 22 32 35 38 49 61 62 64 71 90 93 106 109 114 117 120 127 128 131 141 153 154 159 169 170 175 181 182 187 193 198 200 207 211
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## 14. Conclusions

This dissertation has introduced the alp which provides another useful characterization of designs. The alp of a design contains the number of clear two-factor interactions, the number of degrees of freedom used for main effects and two-factor interactions, and lists the length of the largest set of aliased two-factor interactions. The alp can be used to calculate the number of length-four words, and is helpful in differentiating designs.

We have also studied projections of designs. We now know that all regular resolution IV designs have at least one sos parent. We know an examination of projections from all the sos designs will result in a complete set of regular resolution IV designs. We have introduced a method to find good designs using naïve projections from sos designs instead of an exhaustive search.

We have examined some of the properties of the T matrix and demonstrated its usefulness in searching for good designs. We have found the minimum aberration designs for n = 128 based upon our isomorphic conjecture. We list not only these designs and their properties, but provide a catalog of designs with respect to word length pattern, degrees of freedom used, clear two-factor interactions, and minimizing the length of the longest set of aliased two-factor interactions.

We know that the naïve projections from sos designs leads to all the minimum aberration values for n = 32, 64, and 128. We know that the number of regular resolution IV designs increases at a rate that makes exhaustive searches infeasible beyond n = 128 using current technology. We know that projections from the doubled sos design at k = (5/16)n results in excellent (and very often minimum aberration) designs. We

provide a number of interesting designs at n = 128 that are alike in several (sometimes all) characterization criteria, yet non-isomorphic.

Finally, we have found over 34,015 sos designs for n = 256. We show how the magnitude of the number of designs increases with larger n. We use naïve projections and build up using the best 2,000 designs to provide a preliminary table of the best designs at n = 256.

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## Appendices

Appendix A: Yates Column Order Design Matrix

Yates Column Order Generator Matrix, For  $r > 129,...,255 \ i_r = i_{128} + i_{r-128}$ 

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255 i = i...Yates Column Order Generator Matrix (Continued), For r > 129,.

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	82	0	_	0	0	-	0	-	102	0	-	_	0	0	_	-
rates column Of the General of Matrix (Continued), For $\Gamma > 1.29,,255$ $I_1 = I_{128} + I_{r-128}$	- 18	_	0	0	0	_	0		101	_	0	_	0	0	_	
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Appendix B: Catalog of Even/Odd Resolution IV Design for n = 64

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Design	CSW#	csw# Generators	d.f.	d.f. w4, w5, w6,	Alias Length Pattern	E/O Proj.
20-14.a	-	7,11,13,14,19,21,22,35,37,38,57,58,60,63	63	125, 256, 480,	0,0,0,40,0,0,0,0,3	а
19-13.a	-	7 11 13 14 19 21 22 35 37 38 57 58 60	62	100, 192,	0,0,16,24,0,0,0,3	a, b
18-12.a	-	7 11 13 14 19 21 22 35 37 57 58 60	61	78, 144,	0,3,25,12,0,0,0,3	a, c
18-12.b	7	7 11 13 14 19 21 22 35 37 38 57 58	61	84, 128,	0,16,0,24,0,0,0,2,1	c, h
18-12.c	3	7 11 13 14 19 21 22 25 26 35 60 63	63	92, 112,	0,30,0,0,0,14,0,0,1	f, i
17-11.a	-	7 11 13 14 19 21 35 37 57 58 60	09	59, 108,	0, 9, 27, 4, 0, 0, 3	a, c
17-11.b	2	7 11 19 29 37 41 47 49 55 59 62	63	60, 80,	16, 0, 0, 30	þ
17-11.c	*	7 11 13 14 19 21 22 35 37 57 58	09	64, 96,	2, 14, 12, 12, 0, 0, 2, 1	c, f, g, i
17-11.d	3	7 11 13 19 21 25 35 37 41 49 63	63	65, 75,	16, 0, 15, 0, 15	p, d
17-11.e	4	7 11 13 14 19 21 25 35 37 41 63	63	68, 72,	16, 6, 0, 18, 0, 6	d, h
17-11.f	*	7 11 13 14 19 21 22 25 35 60 63	62	68, 88,	4, 26, 0, 0, 12, 2, 0, 1	e, g, j
17-11.g	2	7 11 13 14 19 21 22 25 35 37 63	63	73, 67,	19, 0, 12, 0, 12, 0, 3	h, i, j
17-11.h	7	7 11 13 14 19 21 22 35 37 38 57	09	76, 64,	16, 0, 0, 24, 0, 0, 0, 3	i,
17-11.i	10	7 11 13 14 19 21 22 25 26 35 60	62	84, 56,	16, 14, 0, 0, 0, 14, 0, 1	j, k
17-11.j	9	7 11 13 14 19 21 22 25 26 28 63	63	105, 35,	31, 0, 0, 0, 0, 0, 15	¥
16-10.a	-	7 11 13 19 21 35 37 57 58 60	59	43, 81,	0, 18, 22, 0, 0, 3	a, b, d
16-10.b	7	7 11 19 29 37 41 47 49 55 59	19	45, 60,	15, 0, 15, 15	ပ

Design	CSW#	Generators	d.f.	d.f. w4, w5, w6,	Alias Length Pattern	E/O Proj.
16-10.c	7	7 11 13 14 19 21 35 37 57 58	59	47, 72,	4, 15, 17, 4, 0, 2, 1	d, h, j, 1
16-10.d	8	7 11 13 19 21 25 35 37 41 63	61	49, 56,	15, 6, 9, 9, 6	c, f, i
16-10.e	∞	7 11 13 14 19 21 25 35 60 63	61	49, 68,	8, 22, 0, 9, 5, 0, 1	e, g, j, m
16-10.f	6	7 11 13 14 19 21 22 35 57 60	69	51, 64,	4, 24, 0, 12, 0, 1, 2	h, n
16-10.g	*	7 11 13 14 19 21 22 35 57 58	57	52, 64,	0, 26, 0, 12, 0, 2, 0, 1	j, n
16-10.h	4	7 11 13 14 19 21 25 35 37 63	61	53, 52,	18, 3, 9, 9, 3, 3	i, k, l, m
16-10.i	10	7 11 13 14 19 21 22 35 37 57	28	57, 48,	15, 0, 12, 12, 0, 0, 3	l, n
16-10.j	5	7 11 13 14 19 21 22 25 35 60	09	61, 44,	17, 12, 0, 0, 12, 2, 1	m, n, o
16-10.k	9	7 11 13 14 19 21 22 25 26 60	09	77, 28,	29, 0, 0, 0, 0, 14, 1	0
15-9.a	-	7 11 19 30 37 41 49 60 63	58	30, 60,	0, 30, 10, 0, 3	ಣ
15-9.b	2	7 11 19 29 30 37 41 49 60	28	30, 61,	0, 30, 10, 0, 3	a, c
15-9.c	3	7 11 19 29 37 41 47 49 55	59	33, 44,	14, 6, 17, 7	d, g
15-9.d	9	7 11 13 19 21 35 37 57 58	58	33, 54,	6, 19, 15, 0, 2, 1	a, c, h, j, n
15-9.e	7	7 11 13 19 21 25 35 60 63	09	34, 52,	12, 18, 5, 9, 0, 1	b, e, f, j, o
15-9.f	<b>∞</b>	7 11 13 19 21 35 41 49 63	59	35, 42,	14, 11, 8, 10, 1	d, i, k
15-9.g	*	7 11 13 14 19 21 41 54 63	09	35, 50,	12, 18, 8, 3, 3, 1	e, m, q
15-9.h	*	7 11 13 14 19 21 35 57 60	28	36, 48,	8, 20, 8, 4, 1, 2	h, l, m, r
15-9.i	6	7 11 13 19 21 25 35 37 63	59	37, 40,	17, 6, 11, 7, 3	g, i, k, n, o

Design	CSW#	Generators	d.f.	d.f. w4, w5, w6,	Alias Length Pattern	E/O Proj.
15-9.j	*	7 11 13 14 19 21 35 57 58	99	37, 48,	4, 22, 8, 4, 2, 0, 1	j, m, p, r
15-9.k	4	7 11 13 14 19 21 35 41 63	59	39, 38,	19, 2, 16, 2, 4, 1	k, q, r
15-9.1	*	7 11 13 14 19 21 35 37 57	99	41, 36,	14, 3, 17, 4, 0, 3	n, r
15-9.m	10	7 11 13 14 19 21 25 35 60	58	43, 34,	18, 10, 0, 9, 5, 1	o, q, r, s
15-9.n	*	7 11 13 14 19 21 22 35 57	26	45, 32,	14, 12, 0, 12, 0, 2, 1	r, t
15-9.0	2	7 11 13 14 19 21 22 25 58	57	55, 22,	27, 0, 0, 0, 12, 3	s, t
14-8.a	_	7 11 19 30 37 41 49 60	57	22, 40, 36,	8, 26, 6, 2, 1	d, h, o
14-8.b	2	7 11 19 29 30 37 41 47	65	22, 40, 41,	16, 14, 14, 0, 1	a, i, m
14-8.c	9	7 11 19 29 30 37 41 49	57	22, 41,	8, 26, 6, 2, 1	d, i, 1, o
14-8.d	7	7 11 19 30 37 41 52 56	57	23, 32,	13, 15, 12, 3	c, f
14-8.e	∞	7 11 13 19 21 41 54 63	59	23, 38,	16, 17, 8, 3, 1	a, e, h, k, p
14-8.f	6	7 11 13 19 21 46 54 56	59	23, 40,	16, 17, 8, 3, 1	e, i, q
14-8.g	10	7 11 19 29 37 41 47 49	57	24, 31,	16, 9, 15, 3	f, m, o
14-8.h	*	7 11 13 19 21 35 57 60	57	24, 36,	12, 19, 9, 1, 2	d, g, k, s
14-8.i	*	7 11 13 19 21 41 49 63	57	25, 30,	16, 12, 9, 6	f, j, l, p, q
14-8.j	*	7 11 13 19 21 35 57 58	55	25, 36,	8, 21, 9, 2, 0, 1	h, i, k, r, s
14-8.k	*	7 11 13 19 21 35 41 63	57	26, 29,	18, 8, 12, 4, 1	f, j, p, s
14-8.1	*	7 11 13 14 19 37 57 63	57	26, 32,	12, 24, 0, 4, 3	g, t

Design	CSW#	Generators	d.f.	d.f. w4, w5, w6,	Alias Length Pattern	E/O Proj.
14-8.m	*	7 11 13 14 19 35 53 57	55	27, 32,	8, 26, 0, 5, 1, 1	k, t, u
14-8.n	*	7 11 13 19 21 35 37 57	54	28, 27,	13, 9, 15, 0, 3	l, s
14-8.0	3	7 11 13 19 21 25 35 60	99	29, 26,	19, 8, 5, 9, 1	m, p, q, s, v
14-8.p	*	7 11 13 14 19 35 53 54	51	29, 32,	0, 30, 0, 6, 0, 0, 1	r, u
14-8.q	*	7 11 13 14 19 21 41 54	99	30, 25,	19, 8, 8, 3, 4	p, t, w, x
14-8.r	*	7 11 13 14 19 21 35 57	54	31, 24,	15, 10, 8, 4, 2, 1	s, t, u, w
14-8.s	4	7 11 13 14 19 21 25 54	54	38, 17,	25, 0, 0, 9, 6	v, w, x
14-8.t	2	7 11 13 14 19 21 22 57	54	39, 16,	25, 0, 0, 12, 0, 3	W
13-7.a	1	7 11 21 25 38 58 60	28	14, 28,	20, 18, 6, 1	b, e, g, i
13-7.b	7	7 11 13 30 46 49 63	63	14, 33,	36, 0, 14	a, h
13-7.c	8	7 11 19 29 37 59 62	55	15, 24,	12, 27, 0, 3	f
13-7.d	4	7 11 19 29 37 41 60	99	15, 27,	16, 21, 4, 2	c, g, k, m
13-7.e	5	7 11 13 19 46 49 63	58	15, 28,	22, 15, 6, 2	b, g, h, j, l
13-7.f	9	7 11 19 30 37 41 52	55	16, 22,	17, 15, 9, 1	d, f, i, m
13-7.g	7	7 11 13 19 37 57 63	99	16, 24,	18, 18, 4, 3	c, e, p
13-7.h	∞	7 11 19 37 41 60 63	54	16, 26,	12, 23, 5, 0, 1	g, k, n
13-7.i	*	7 11 19 29 30 37 41	54	16, 28,	12, 23, 5, 0, 1	g, m, o
13-7.j	*	7 11 13 19 37 49 63	55	17, 21,	19, 12, 9, 2	d, i, k, l, p

Design	CSW#	csw# Generators	d.f.	d.f. w4, w5, w6,	Alias Length Pattern	E/O Proj.
13-7.k	*	7 11 13 19 35 53 57	54	17, 24,	19, 12, 9, 2	e, g, j, n, p, q
13-7.1	*	7 11 19 30 37 41 49	52	18, 20, 24,	12, 18, 6, 3	k, m
13-7.m	6	7 11 19 29 37 41 47	54	18, 20, 28,	20, 6, 14, 1	i, m, r
13-7.n	10	7 11 13 19 35 49 63	55	18, 21, 24,	21, 8, 12, 0, 1	f, l, q
13-7.0	*	7 11 19 29 37 41 49	52	18, 21, 24,	12, 18, 6, 3	В
13-7.p	*	7 11 13 19 21 41 54	54	19, 19,	20, 9, 8, 4	i, k, l, p, t, n
13-7.q	*	7 11 13 19 21 46 54	54	19, 20,	20, 9, 8, 4	l, u
13-7.r	*	7 11 13 19 35 53 54	20	19, 24,	6, 24, 6, 0, 0, 1	s, q, o, n
13-7.s	*	7 11 13 19 21 35 57	52	20, 18,	16, 11, 9, 2, 1	k, m, p, q, t
13-7.t	*	7 11 13 14 19 37 57	52	22, 16,	16, 16, 0, 5, 2	p, v
13-7.u	*	7 11 13 14 19 35 53	50	23, 16,	12, 18, 0, 6, 0, 1	d, v
13-7.v	*	7 11 13 19 21 25 46	51	25, 13,	23, 0, 5, 10	r, t, u
13-7.w	*	7 11 13 14 19 21 57	51	26, 12,	23, 0, 8, 4, 3	t, v
13-7.x	*	7 11 13 14 19 21 54	51	26, 13,	23, 0, 8, 4, 3	u, v
12-6.a	-	7 11 29 45 51 62	62	6, 24,	36, 12, 2	g
12-6.b	7	7 11 21 46 54 56	57	8, 20,	27, 15, 3	a, c, d, e
12-6.c	3	7 11 21 41 51 63	55	9, 18,	24, 15, 4	c, h
12-6.d	4	7 11 21 41 54 56	53	10, 15,	21, 15, 5	b, d, h

Design	CSW#	Generators	d.f.	W4, W5, W6,	Alias Length Pattern	E/O Proj.
12-6.e	9	7 11 19 37 57 63	53	10, 16, 12,	20, 18, 2, 1	c, g, j
12-6.f	7	7 11 19 29 37 59	53	10, 16, 16,	20, 18, 2, 1	d, f, l
12-6.g	∞	7 11 19 29 37 57	53	10, 18,	20, 18, 2, 1	c, e, h, i, j, l
12-6.h	2	7 11 13 30 46 49	99	10, 20,	30, 6, 8	a, e, k, m
12-6.i	6	7 11 21 25 38 58	52	11, 14,	21, 12, 7	d, g, h, o
12-6.j	*	7 11 19 37 57 60	51	11, 16,	16, 21, 0, 2	e, j
12-6.k	*	7 11 19 37 41 60	20	12, 13,	17, 15, 5, 1	h, j, n, o
12-6.1	10	7 11 13 19 46 49	52	12, 14, 12,	23, 9, 7, 1	d, h, j, k, p, r
12-6.m	*	7 11 19 29 37 41	20	12, 14, 12,	17, 15, 5, 1	h, 1, o
12-6.n	*	7 11 19 37 57 58	49	12, 16,	12, 23, 1, 0, 1	i, j, r
12-6.0	*	7 11 19 29 30 37	49	12, 20,	12, 23, 1, 0, 1	i, 1, s
12-6.p	*	7 11 13 19 37 57	50	13, 12,	19, 12, 5, 2	g, h, j, p
12-6.q	*	7 11 13 19 35 53	48	14, 12,	15, 14, 6, 0, 1	j, 1, p, q
12-6.r	*	7 11 21 25 31 45	48	15, 10,	21, 0, 15	0
12-6.s	*	7 11 19 29 30 35	43	15, 16,	0, 30, 0, 0, 0, 1	d, s
12-6.t	*	7 11 13 19 21 57	48	16, 9,	21, 3, 9, 3	n, o, p
12-6.u	*	7 11 13 19 21 46	48	16, 10,	21, 3, 9, 3	r, p, o
12-6.v	*	7 11 13 14 19 53	48	18, 8,	21, 8, 0, 6, 1	p, t

Design	CSW#	Generators	d.f.	W4, W5, W6,	Alias Length Pattern	E/O Proj.
11-5.a	-	7 11 29 45 51	55	4, 14,	34, 9, 1	a, c, f
11-5.b	2	7 25 42 52 63	51	5, 10,	25, 15	þ
11-5.c	3	7 11 29 46 49	52	5, 12,	28, 12, 1	a, b, d, e
11-5.d	4	7 11 21 46 56	20	6, 10,	25, 12, 2	b, c, e, h
11-5.e	2	7 11 29 45 49	20	6, 12, 4,	25, 12, 2	a, e, f
11-5.f	9	7 11 19 29 62	51	6, 12, 8,	27, 12, 0, 1	c, j
11-5.g	7	7 11 21 38 57	48	7, 8,	22, 12, 3	b, g
11-5.h	<b>∞</b>	7 11 21 41 51	48	7, 9,	22, 12, 3	b, e, g, h
11-5.i	*	7 11 19 29 45	48	7, 12,	21, 15, 0, 1	d, e, f, i, j
11-5.j	*	7 11 19 37 57	46	8, 8,	18, 15, 1, 1	e, g, i
11-5.k	6	7 11 13 30 49	46	8, 10, 4,	28, 3, 7	c, e, k, l
11-5.1	*	7 11 19 29 37	46	8, 10, 4,	18, 15, 1, 1	e, h, j
11-5.m	10	7 11 13 30 46	49	8, 14,	28, 3, 7	f,1
11-5.n	*	7 11 21 25 63	45	9, 6,	19, 9, 6	60
11-5.0	*	7 11 21 25 45	45	9, 7,	19, 9, 6	g, h
11-5.p	*	7 11 13 19 53	45	10, 6,	21, 6, 6, 1	g, h, i, k
11-5.q	*	7 11 19 29 35	42	10, 8, 0,	10, 20, 0, 0, 1	i, j
11-5.r	*	7 11 13 19 46	45	10, 8, 4,	21, 6, 6, 1	į

Design	CSW#	Generators	d.f.	W4, W5, W6,	Alias Length Pattern	E/O Proj.
11-5.8	*	7 11 19 29 30	42	10, 16,	10, 20, 0, 0, 1	k
11-5.t	*	7 11 13 14 51	45	14, 4,	27, 0, 0, 7	h, i, 1
10-4.a	-	7 27 43 53	49	2, 8,	33, 6	a, c
10-4.b	2	7 25 42 53	46	3, 6,	27, 9	a, b
10-4.c	c	7 11 29 51	47	3, 7,	30, 6, 1	a, e, f
10-4.d	4	7 11 29 46	47	3, 8,	30, 6, 1	a, f
10-4.e	2	7 11 29 49	44	4, 6,	24, 9, 1	a, b, c, d, f
10-4.f	9	7 11 29 45	44	4, 8,	24, 9, 1	c, f
10-4.g	<b>∞</b>	7 11 21 57	42	5, 4,	21, 9, 2	p, q
10-4.h	6	7 11 21 45	42	5, 5,	21, 9, 2	b, d, e, f
10-4.i	*	7 11 19 45	40	6, 4,	17, 12, 0, 1	d, f
10-4.j	*	7 11 19 29	40	6, 8,	17, 12, 0, 1	f
10-4.k	*	7 11 13 51	41	7, 3,	24, 0, 7	d, e
10-4.1	*	7 11 13 30	41	7, 7,	24, 0, 7	f
9-3.a	1	7 2 7 4 5	42	1, 4,	30,3	a, c
9-3.b	2	7 25 43	39	2, 3,	24, 6	a, b, c
9-3.c	3	7 2 7 4 3	39	2, 4,	24, 6	၁
9-3.d	9	7 11 53	37	3, 2,	21, 6, 1	p, c

Design	CSW#	esign csw# Generators	d.f.	d.f. w4, w5, w6,	Alias Length Pattern E/O Proj.	E/O Proj.
9-3.e	7	7 11 51	37	37 3, 3,	21, 6, 1	၁
9-3.f	<b>∞</b>	7 11 29	37	37 3, 4,	21, 6, 1	ပ
8-2.a	-	15 51	36	36 0, 2, 1,	28	•
8-2.b	*	757	33	1, 1,	22, 3	ı
8-2.c	*	727	33	1, 2,	22, 3	•

Appendix C: Catalog of Designs, n = 128

k = 8, Designs sorted based on word length pattern

	rank	98 1	98 2	99 3	77 4	32 5
	: CD2*	55.0998	55.0998	55.0999	55.1007	55.1082
	Lmax rank		7	Э	4	ഗ
	df C2FI rank rank	1	7	က	4	S.
	df rank	-	2	m	4	5
	Lmax	-	⊣	Н	H	2
	C2FI Lmax	28	28	28	28	22
1	d. f	36	36	36	36	33
	alp	28 0 0 0	28 0 0 0	28 0 0 0	28 0 0 0	22 3 0 0
	wlp rank	٦	7	m	4	2
			0	0	0	0
ľ	(W41)	0	_	0	0	0
	_		0	0	1 0	٦
,	wlp	0	0	0	0	, I
	Design	8-1.1	8-1.2	8-1.3	8-1.4	8-1.5

## k = 8, Design generators

Destail	Design Generators
8-1.1	127
8-1.2	63
8-1.3	121
8-1.4	15
8-1.5	7

k = 9, Designs sorted based on word length pattern

CD2 rank	-	7	m	4	Ŋ	9	7	<b>o</b> o	σ	10	11	12	13	
CD2*	49.5901	49.5908	49.5915	49.5916	49.5974	49.5975	49.5976	49.5982	49.5982	49.5991	49.6049	49.6050	49.6125	
Lmax rank		2	m	4	S		7	∞	6	10	11	12	13	
df C2FI Lmax rank rank rank	1	2	m	4	വ	9	7	ω	6	10	11	12	13	
df rank	1	2	m	4	2	9	7	ω	6	10	11	12	13	
C2FI Lmax	Ч	<del></del> 1	Н	Н	7	2	7	2	7	7	7	2	m	
CZFI	36	36	36	36	30	30	30	30	30	30	24	24	21	
df	45	45	45	45	42	42	42	42	42	42	39	39	37	
	0	0	0	0	0	0	0	0	0	0	0	0	0	
alp	0	0	0	0	0	0	0	0	0	0	0	0	Н	
10	0	0	0	0	m	m	m	m	m	ന	9	9	9	
	36	36	36	36	30	30	30	30	30	30	24	24	21	
wlp rank	1	7	m	4	2	9	7	∞	0	10	11	12	13	
	0	0	0	0	0	0	0	Н	0	0	0	0	0	
	0	0	H	0	0	Н	0	0	0	0	-	0	0	
	0	Н	0	0	0	0	0	0	Н	0	0	0	0	
V41	m	-1	0	Н	0	Н	0	0	0	0	0	~-1	0	
wlp (w4,	0	Н	7	7	0	0	0	$\vdash$	<del>, - i</del>	7	0	0	0	
wl	0	0	0	0	$\leftarrow$	$\vdash$		_	Н	Н	N	0	m	
Design	9-2.1	9-2.2	2	9-2.4	9-2.5	9-2.6	9-2.7	9-2.8	9-2.9	9-2,10	9-2.11	9-2.12	9-2.13	

k = 9, Design generators

	טרטוקון פרוורומומר מרכו ט
31	121
15	121
15	120
15	51
7	123
7	121
7	59
7	120
7	57
7	27
7	112
7	25
7	11

k = 10, Designs sorted based on word length pattern

	Mlp (	D (W4,	_	wlp.		al	1p			df (	CZFI	Lmax	df.	-		CD2*	CD2
				rank									rank	rank	rank		rank
	0	m	m	-	45	0	0	0	0	55	45	1	1		1	44.6334	1
	0	4	8	2	45	0	0	0	0	52	45	Н	7	7	7	44.6340	7
	Н	0	9	m	39	n	0	0	0	52	39	7	n	က	က	44.6381	m
æ	Н	0	2	4	39	m	0	0	0	52	39	7	4	4	4	44.6393	4
0	<b>-</b> -i	2	~	4	39	m	0	0	0	52	39	2	4	4	4	44.6393	4
	1	m	$\vdash$	9	39	m	0	0	0	52	39	2	9	9	9	44.6400	9
	$\vdash$	8	7	7	39	m	0	0	0	52	39	2	7	7	7	44.6401	7
	Н	4	0	œ	39	m	0	0	0	52	39	2	ω	ω	ω	44.6407	∞
	П	4	$\vdash$	6	39	m	0	0	0	52	39	2	0	6	6	44.6408	6
-3.10	Н	4	2	10	39	$\mathfrak{C}$	0	0	0	52	39	7	10	10	10	44.6408	10
la Ia	7	0	4	11	33	9	0	0	0	49	33	7	11	11	11	44.6448	11
1b	7	0	4		33	9	0	0	0	49	33	7	11	11	11	4	11
m	7	П	-		33	9	0	0	0	49	33	7	13	13		44.6453	13
4	7	2	0	14	33	9	0	0	0	49	33	7	14	14		44.6460	14
S	2	0	Н	15	33	9	0	0	0	49	33	7	15	15		44.6461	15
9	7	m	Н	16	33	9	0	0	0	49		7	16				16
7	2	4	0	17	33	9	0	0	0	49	33	7	17	17	17	44.6475	
œ	m	0	0	18	30	9	М	0	0	47	30	က	18			44.6513	18
0	m	0	7	19	30	9	<del>,  </del>	0	0		30	m	19	19		44.6514	19
0	m	0	2	19	27	0	0	0	0	46	27	7	26			44.6514	19

k=10, Designs sorted based on degrees of freedom used

CD2	rank	1	7	m	4	4	9	7	80	6	10	11	11	13	14	15	16		18	19	21
CD2*		6334	6340	6381	6393	6393	6400	6401	6407	6408	6408	6448	6448	6453	6460	6461	6468	6475	6513	6514	6515
0		44.	44.	44.	44.	44.	44.	44.	44.	44.	44.	44.	44.	44.	44.	44.	44.	44.	44.	44.	44.
Lmax	rank	1	2	e	4	4	9	7	œ	0	10	11	11	13	14	15	16	17	21	22	23
	rank	П	7	m	4	4	9	7	œ	0	10	11	11	13	14	15	16		18	19	20
df	rank	Н	2	ო	4	4	9	7	œ	0	10	11	11	13	14	15	16	17	18		20
Lmax		H	<b>~</b>	7	7	7	7	7	7	7	7	7	7	7	2	7	7	2	ო	m	m
CZFI		45	45	39	39	39	39	39	39	39	39	33	33	33	33	33	33	33	30	30	30
ď£		55	52	52	52	52	52	52	52	52	52	49	49	49	49	49	49	49	47	47	47
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
alp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Н	٦	Н
m		0	0	m	m	m	m	m	m	m	m	9	9	9	9	9	9	9	9	9	9
			45		39	39		39	39	39	39	33	33	33		33	33	33	30	30	30
wlp	rank	-	7	m	4	4	9	7	ω	6	10	11	11	13	14	15		17	18		21
<u></u>		3	7	9	7	2	Н	7	0	-1	7	4	4	Н	0	_		0	0	2	m
wlp (w4,)		m	4	0	7	7	r	m	4	4	4	0	0	٦	7	7	m	4	0	0	0
wli		0	0	Н	۲	IJ	٦	<b>+</b>	Ч	$\leftarrow$	Н	7	7	7	7	7	7	7	က	m	c
Design		10-3.1	10-3.2	10-3.3	10-3.4b	10-3.4a	10-3.6	10-3.7	10-3.8	10-3.9	10-3.10	10-3.11b	10-3.11a	10-3.13	10-3.14	10-3.15	10-3.16	10-3.17	10-3.18	10-3.19	10-3.21

k=10, Designs sorted based on the number of clear two-factor interactions

1	1																					
CD2 rank		IJ	7	m	4	4	9	7	œ	6	10	11	11	13	14	15	16	17	18	19	21	
CD2*		44.6334	44.6340	44.6381	44.6393	44.6393	44.6400	44.6401	44.6407	44.6408	44.6408	44.6448	44.6448	44.6453	44.6460	44.6461	44.6468	44.6475	44.6513	44.6514	44.6515	
Lmax rank		1	7	m	4	4	9	7	ω	6	10				14	15	16	17	21	22	23	
C2FI		-1	7	m	4	4	9	7	ω	0	10		11	13	14	15	16	17	18	19	20	
df rank		1	7	m	4	4	9	7	ω	თ	10	11	11	13	14	15	16	17		19		
Lmax		1	<del>1</del>	7	7	7	7	7	7	7	7	7	7	7	7	7	7	2	ო	m	Μ	
CZFI		4	4	m	m	m	m	n	Ю	n	39	m	m	m	m	m	m	m	m	30	30	
d.		55	55	52	52	52	52	52	52	52	52	49	49	49	49	49	49	49	47	47	47	
		0	0	0	0	0	0	0	0	0	0	0	0	Ó	0	0	0	0	0	0	0	
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	~~1	Н	Н	
alp		0	0	m	m	m	m	က	n	m	က	9	9	9	9	9	9	9	9	9	9	
		45	45	39	39	39	39	39	39	39	39	33	33	33	33	33	33	33	30	30	30	
wlp		1	2	m	4	4	9	7	8	0	10			13	14	15	16	17		19	21	
<u>.</u>		m	7	9	~	0	Н	8	0		7	4	4	Н	0	H	Н	0	0	8	m	
(W4 r		m	4	0	7	7	m	ĸ	Ą	4	4	0	0	Н	2	7	m	4	0	0	0	
wlp			_	•							Н											
Design		10-3.1	10-3.2	10-3.3	10-3.4a	10 - 3.4b	10-3.6	10-3.7	10-3.8	10-3.9	10-3.10	10-3.11a	10-3:11b	10-3.13	10-3.14	10 - 3.15	10-3.16	10-3.17	10-3.18	10-3.19	10-3.21	

k = 10, Designs sorted based on minimizing Lmax

* CD2 rank	34 1	0	81 3	93	93	00	01	07 8	80	08 10	48 11	48 11	53 13	60 14	61 15	68 16	75 17	14 19	15 21	
CDS	44.63	44.634	44.638	44.63	44.63	44.64	44.64	44.64	44.64	44.64	44.64	44.64	44.64	44.64	44.64	44.64	44.64	44.65	44.65	AA CE
Lmax rank	7	2	٣	4	4	9	7	8	g	10	11	11	13	14	15	16	17	18	19	00
C2FI rank	-1	2	m	4	4	9	7	œ	σ	10	11	11	13	14	15	16		26		
df rank	1	2	т	4	4	9	7	œ	σ	10	11	11	13		15	16	17	26	27	00
Lmax		Н	7	2	7	7	2	7	2	7	7	7	7	7	2	7	7	2	2	c
C2FI	45	45	39	39	39	39	39	39	39		33	33	33	33	33	33	33	27	27	77
df	55	55	52	52	52	52	52	52	52	52	49	49	49	49	49	49	49		46	
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	c
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	c
alp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	C
์เช	0				3														9	σ
	45	45	39	39	39	39	39	39	39	39	33	33	33	33	33	33	33	27	27	77
wlp rank		7	က	4	4	9	7	8	თ	10		11	13	14	15	16	17	19	21	23
(W4, r)	m	7	9	7	7	Н	7	0	Н	7	4	4	Н	0	Н	$\leftarrow$	0	7	m	V
( W <sub>4</sub>	6	4	0	7	7	m	m	4	4	4	0	0	Н	7	7	က	4	0	0	C
wlp	0	0	Н	Н	Н		Н	Н	Н	Н	7	7	2	7	7	7	7	m	ო	~
Design	10-3.1	10-3.2	10-3.3	10-3.4b	10-3.4a	10-3.6	10-3.7	10-3.8	10-3.9	10-3.10	10-3.11b	10-3.11a	10-3.13	10-3.14	10-3.15	10-3.16	10-3.17	10-3.20	10-3.22	

k = 10, Design generators

Design Generators																								
Design G	15 51 121	51	59	27				27		27	,	7 59 112					51		121	112	11		25	
Design	10-3.1	10-3.2	10-3.3	10-3.4a	10 - 3.4b	10-3.6	10-3.7	10-3.8	10-3.9	10-3.10	10-3.11a	10-3.11b	10-3.13	10-3.14	10-3.15	10-3.16	10-3.17	10-3.18	10-3.19	10-3.20	10-3.21	10-3.22	10-3.24	

k = 11, Designs sorted based on word length pattern

CD2 rank	1	2	ო	4	2	9	7	∞	0	σ	0	12	13	13	15	16	17	18	19	20
CD2*	0.1	40.1771	40.1778	40,1783	40.1784	40.1784	40.1789	40.1809	40.1831	40.1831	40.1831	40.1837	40.1843	40.1843	40.1843	40.1844	40.1857	40.1869	40.1870	40.1878
Lmax rank	1	7	ო	4	Ŋ	9	7	80	6	6	0	12	13	13	15		17	18	31	19
C2FI	1	7	m	4	S	9	7	œ	6	6	6	12	13	13	15	16	17	32	18	33
df rank	П	7	က	4	2	9	7	œ	σ	თ	6	12	13	13	15	16	17	32		33
Lmax	F	7	2	7	7	7	7	2	2	7	7	7	2	2	7	7	7	7	ო	7
CZFI	55	49	49	49	49	49	49	43	43	43	43	43	43	43	43	43	43	37	40	37
df	99	63	63	63	63	63	63	9	9	09	9	9	09	9	9	9	9	57	58	57
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
alp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Н	0
1.0	0	സ	က	m	ო	က	m	9	9	9	9	9	9	9	9	9	9	6	9	9
	55	49	49	49	49	49	49	43	43	43	43	43	43	43	43	43	43	37	40	37
wlp rank	-1	2	m	4	2	9	7	œ	6	6	6	12	13	13	15	16	17	18	19	20
wlp(w4,)	9	9	9	4	Ŋ	9	4	12	4	4	4	4	7	2	m	4	4	10	11	4
Q.	9	4	S	9	9	9	7	0	4	4	4	വ	9	9	9	9	ω	0	0	7
W	0	Н	Н	~	Н	Н	7	7	7	7	2	7	7	7	7	7	7	m	m	က
Design	11-4.1	11-4.2	11-4.3	11-4.4	11-4.5	11-4.6	11-4.7	11-4.8	11-4.9a	11 - 4.9b	11-4.9c	11-4.12	11-4.13a	11-4.13b	11-4.15	11-4.16	11-4.17	11-4.18	11-4.19	11-4.20

k = 11, Designs sorted based on degrees of freedom used

, <sub>1</sub>	rank	), }	١.		1		Ä		rank	rank	 	rank
							1					,
0		0		0		55	1	1	1	1	40.1723	<del>,  </del>
3		0	0	0			2	2	7	2	40.1771	2
3		0	0	0		49	2	ო	m	m	40.1778	m
3	49 3	0	0	0	63 4	49	2	4	4	4	40.1783	4
3		0	0	0		49	2	2	വ	2	40.1784	വ
3	49 3	0	0	0		49	2	9	9	9	40.1784	Ø
33	49 3	0	0	0		49	2	7	7	7	40.1789	7
9 8	43 6	0	0	0		43	2	œ	∞	<b>ω</b>	40.1809	∞

k = 11, Designs sorted based on the number of clear two-factor interactions

Design	Wlr	W4	(W4,)	wlp		10	alp			d£	C2FI Lmax		dfrank	C2FI rank	Lmax	CD2*	CD2 rank
11-4.1	0	9	9	Т	55	0	0	0	0	99	55	<u>ا</u> ۔۔ا	П	г	<b>~</b>	40.1723	Н
11-4.2	Н	4	9	2	49	Μ	0	0	0	63	49	2	7	7	2	40.1771	2
11-4.3	Н	Ŋ	9	က	49	m	0	0	0	63	49	7	m	m	m	40.1778	m
11-4.4	Н	9	Ą	4	49	m	0	0	0	63	49	7	4	4	4	40.1783	4
11-4.5	<del></del> 1	9	Ŋ	Ŋ	49	რ	0	0	0	63	49	7	Ŋ	2	Ŋ	40.1784	2
11-4.6	⊣	9	9	9	49	m	0	0	0	63	49	7	9	9	9	40.1784	9
11-4.7	Н	7	4	7	49	ო	0	0	0	63	49	7	7	7	7	40.1789	۲.
11-4.8	2	0	12	80	43	9	0	0	0	9	43	7	ω	ω	ω	40.1809	∞

k = 11, Designs sorted based on minimizing Lmax

Design	Wlk	( W4	wlp (w4,)	wlp rank		10	alp			d£	CZFI	C2FI Lmax	df rank	C2FI rank	Lmax	CD2*	CD2 rank
11-11	c	9	4	-	u	c	c	c		99	u	٦	F	٦	,	1 0 1	
7.5-77	>	0	0	٦	00	>	>	>	>	00	00	7	4	-	4	40.1123	-
11-4.2	Н	4	9	7	49	e	0	0	0	63	49	7	7	7	7	40.1771	2
11-4.3	7	2	9	ю	49	m	0	0	0	63	49	7	m	က	က	40.1778	က
11-4.4	-1	9	4	4	49	ო	0	0	0	63	49	2	4	4	4	40.1783	4
11-4.5	Н	9	S	ស	49	ო	0	0	0	63	49	7	2	5	S	40.1784	5
11-4.6	Н	9	9	9	49	ო	0	0	0	63	49	7	9	9	9	40.1784	9
11-4.7	-1	7	4	7	49	m	0	0	0	63	49	7	7	7	7	40.1789	7
11-4.8	7	0	12	œ	43	9	0	0	0	9	43	2	œ	œ	80	40.1809	∞
						1											

k = 11, Design generators

11-4.1	15	51	85	120
11-4.2	7	57	90	108
11-4.3	7	27	45	120
11-4.4	7	27	45	121
11-4.5	7	27	45	85
11-4.6	7	27	45	78
11-4.7	7	27	61	120
11-4.8	7	59	93	112
11-4.9a	7	56	45	121
11-4.9b	7	27	45	112
11-4.9c	7	51	93	112
11-4.12	7	25	43	120
11-4.13a	7	27	09	121
11-4.13b	7	27	43	121
11-4.15	7	27	58	121
11-4.16	7	27	43	120
11-4.17	7	51	82	112
11-4.18	7	26	44	121
11-4.19	7	11	61	94
11-1 20	۲	25	7.2	116

k = 12, Designs sorted based on word length pattern

CD2 rank	110	ı m	4 n	ာ ဖ	7	œ	8	10	12	13	11	14	15	16	17	17	17	17
CD2*	36.1623	6.163	36.1672	6.167	۲.	36.1687	36.1687	36.1688	36,1693	36.1699	.169	36.1719	.172	36.1725	36.1729	36.1729	36.1729	36.1729
Lmax rank	110	1 M	44 ⊓	ာ ဖ	7	œ	00	10	11	12	13	14	44	15	45	16	16	16
C2FI rank	1 0	1 M	4 ቤ	n (0	7	<b>o</b> o	80	10	11	12	21	22	13	23	14	24	24	24
df	1 0	ıΜ	4 r	9	7	œ	œ	10	11	12	21	22	13	23	14	24	24	24
Lmax	2 0	1 2	2 0	1 ~	2	2	2	2	7	7	7	7	r	2	ო	7	2	7
CZFI	60		54		54	54	54	54	54	54	48	48	51	48	51	48	48	
df	75	75	72	72	72	72	72	72	72	72	69	69	70	69			69	69
	0 0	0	0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0 0	0	00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	00	0	0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
alp	00	0	0 0	0	0	0	0	0	0	0	0	0	٦	0	٦	0	0	0
	m m	m	o u	9	9	9	9	9	9	9	6	6	9	0	9	0	6	0
	09	9	54	54	54	54	54	54	54	54	48	48	51	48	51	48	48	48
wlp rank	1 2	ıκ	4 ቢ	) <b>(</b> 0	7	80	8	10	11	12		14	15	16	17	17	17	17
	12	11	215	12	6	œ	∞	10	ω	ω	24	2	[]	2	7	7	7	7
wlp (w4,	8	0			0	0		_			0							ω
wlp		ι —	0 0	2 2	2	7												
Design	12-5.1	-5-	12-5.4 12-5 5	-5.	12-5.7	1	1	12-5.10	12-5.11	12-5.12	12-5.13	-5.1	-5.1	-5.1	ï	12-5.18a	12-5.18b	12-5.18c

k = 12, Designs sorted based on degrees of freedom used

Design	wlp (w4,)		wlp		Ø	alp				df (	CZFI	C2FI Lmax	d£	CZFI	Lmax	CD2*	CD2
		ч	ank										rank	rank	rank		rank
12-5.1	1 8 1	2	1	09	m	0	0	0	0	75	09	2	Н	1	1	36.1623	П
12-5.2	1 10 1	0	7	09	m	0	0	0	0	75	09	7	2	7	7	36.1633	7
12-5.3	10	11	m	09	m	0	0	0	0	75	09	7	က	က	က	36.1634	က
12-5.4	7	2	4	54	9	0	0	0	0	72	54	2	4	4	4	36.1672	4
12-5.5	∞	0	2	54	9	0	0	0	0	72	54	7	5	വ	2	36.1676	Ŋ
12-5.6	∞	2	9	54	9	0	0	0	0	72	54	7	9	9	9	36.1677	9
12-5.7	g	0	7	54	9	0	0	0	0	72	54	2	7	7	7	36.1682	7

k=12, Designs sorted based on the number of clear two-factor interactions

CD2 rank	-	7	m	4	S	9	7
CD2*	36.1623	36,1633	36,1634	36.1672	36,1676	36.1677	36.1682
Lmax rank	Н	7	m	4	S	9	7
C2FI rank	-	7	ო	4	Ŋ	9	7
df rank	-1	7	m	4	S	9	7
C2FI Lmax	2	2	7	7	7	7	7
CZFI	09	09	09	54	54	54	54
df	75	75	75	72	72	72	72
	0	0	0	0	0	0	0
	0	0	0	0	0	0	0
	0	0	0	0	0	0	0
alp	0	0	0	0	0	0	0
"	т	m	Μ	9	9	9	9
	09	9	9	54	54	54	54
wlp rank	-	7	٣	4	5	9	7
	12	0	11	2	0	7	9
(W4,	8		10 1	7	8	ω,	0
wlp (w4,)	-	. ·	-	7	7	7	2
Design	12-5.1	12-5.2	12-5.3	12-5.4	12-5.5	12-5.6	12-5.7

k = 12, Designs sorted based on minimizing Lmax

df C2F1 Lmax df C2F1 Lmax CD2* CD2 rank rank rank rank rank 0 75 60 2 1 1 1 36.1623 1 0 75 60 2 2 2 36.1633 2 0 75 60 2 3 3 36.1634 3 0 72 54 2 4 4 4 36.1672 4 0 72 54 2 5 5 5 36.1676 5 0 72 54 2 7 7 7 36.1682 7
75 60 2 1 1 36.1623 75 60 2 2 2 2 36.1633 75 60 2 3 3 3 36.1634 72 54 2 4 4 4 36.1672 72 54 2 5 5 5 36.1676 72 54 2 6 6 6 36.1677 72 54 2 7 7 7 36.1682
75 60 2 1 1 36.1623 75 60 2 2 2 36.1633 72 54 2 4 4 4 36.1672 72 54 2 5 5 5 36.1676 72 54 2 6 6 6 36.1677 72 54 2 7 7 36.1682
75 60 2 2 2 36.1633 75 60 2 3 3 3 36.1634 72 54 2 4 4 4 36.1672 72 54 2 5 5 5 36.1676 72 54 2 6 6 6 36.1677 72 54 2 7 7 36.1682
75 60 2 3 3 3 36.1634 72 54 2 4 4 4 36.1672 72 54 2 5 5 5 36.1676 72 54 2 6 6 6 36.1677 72 54 2 7 7 36.1682
72 54 2 4 4 4 36.1672 72 54 2 5 5 5 36.1676 72 54 2 6 6 6 36.1677 72 54 2 7 7 7 36.1682
72 54 2 5 5 5 36.1676 72 54 2 6 6 6 36.1677 72 54 2 7 7 36.1682
72 54 2 6 6 6 36.1677 72 54 2 7 7 7 36.1682
72 54 2 7 7 7 36.1682

k = 12, Design generators

rators	119	121	120	120	112	120	120	120	120	120	120	120	112	121	120	120	122	121	121	121
Design Generators	90 1	27 45 78	45	45	4	43	43	25 43 85	43	43	45	43	σ	44	53	42	29 46	27 45	26 45	45
	7	7	7	7	5.5 7	7 9	7 7	3a 7	7 d8	10 7	5.11 7	12 7	13 7	14 7	15 7	16 7		.18a 7	. q81	18c 7

k = 13, Designs sorted based on word length pattern

CD2	rank	1	2	e	4	ī,	9	7	7	6	10	11	12	13	14	15	16	17	19		20
CD2*		2.555	2.555	.558	32.5596	32,5597	32.5600	32.5601	32.5601	32,5606	32.5606	32.5611	32.5627	32.5634	32.5635	32.5635	32.5637	32.5640	32.5644	32.5644	32.5644
Lmax	rank	1	2	m	4	2	45	9	9	∞	6	10		11	47	48	49		20	13	14
C2FI	rank		2	4	S	9	က	7	7	9	10	11	12	30	13	14	15	31		32	
df	ank		2	4	Ŋ	9	က	7	7	0	10	11	12	29	13		15				
Lmax	H	2	7	7	2	2	٣	2	2	7	7	7	ന	2	m	က	n	2	e	2	2
C2FI		99	99	09	09	09	63	09	09	09	09	09	57	54	57	57	57	54	57	54	54
df (		85	85	82	82	82	83	82	82	82	82	82	80	79	80	80	80	79	80	79	79
			_	_	_	_	_	_	_		_	_	_	_	_	_	_	_	_		_
						0															
						0															
alp						0															0
10		lo	9	σ	6	σ	9	0	6	6	6	6	6	12	0	9	σ	12	თ		12
		99	99	09	09	9	63	09	9	09	9	9	57	54	22	57	57		57	54	54
wlp	rank		7	m	4	5	9	7	7	6	10		12	13	14	15	16	17	18	18	20
<u></u>		18	20	24	17	18	15	17	17	12	91	.5	22	9	[]	8	22	9	4.	4	τú
wlp (w4,		16	16	12	14	3 14	15	15	15	16	16	17	10	12	12	12	12		14	4 14 1	4 14 1
Design		13-6.1	ė.	ė	ġ	13-6.5	ė.	ė.	3-6.	3-6.	9	3-6.	3-6.	3-6.	ė	13-6.15	3-6.	-6.	-6.	-6.	13-6.20

k = 13, Designs sorted based on degrees of freedom used

														The second secon		
Design	wlp (w4,)	wlp rank			alp				df	CZFI	C2FI Lmax	df rank	C2FI rank	Lmax rank	CD2*	CD2 rank
3-6.1	2 16 18		99	9	0	0	0	0	85	99	2	-	1	1	32.558	T
3-6.2	2 16 20	2	99	9	0	0	0	0	85	99	2	7	2	7	32.5559	7
9.9-	3 15 15	9	63	9	<del></del> 1	0	0	0	83	63	m	m	ო	45	32.5600	ø
13-6.3	3 12 24	m	09	0	0	0	0	0	82	09	2	4	4	က	32,5589	m
-6.4	3 14 17	4	09	0	0	0	0	0	82	09	2	2	S	4	32,5596	4
-6.5	3 14 18	ഹ	09	σ	0	0	0	0	82	09	2	9	9	2	32,5597	S
-6.7b	3 15 17	7	09	6	0	0	0	0	82	09	2	7	7	9	32,5601	7
-6.7a	3 15 17	7	09	9	0	0	0	0	82	09	2	7	7	9	32.5601	7
6.9	3 16 15	6	09	0	0	0	0	0	82	09	7	0	6	ω	32.5606	6
13-6.10	3 16 16	10	09	0	0	0	0	0	82	09	2	10	10	0	32.5606	10

k = 13, Designs sorted based on the number of clear two-factor interactions

Design	Wlp (W4,)	wlp rank			alp				df (	C2FI Lmax		df rank	CZFI	Lmax rank	CD2*	CD2 rank
13-6.1	16	1	99	l o	0	0	0		ιĊ	99	2	<b>←</b>	H	П	32,5558	П
13-6.2	2 16 20	7	99	9	0	0	0	8 0	85	99	7	7	7	7	32.5559	2
13-6.6	3 15 15	9	63	9	1	0	0		m	63	r	ო	ო	45	32.5600	9
13-6.3	3 12 24	m	09	6	0	0	0		82	09	2	4	4	က	32.5589	m
13-6.4	3 14 17	4	09	6	0	0	0		2	09	2	Ŋ	5	4	32.5596	4
13-6.5	3 14 18	Ŋ	09	6	0	0	0		2	09	2	9	9	Ŋ	32.5597	S
13-6.7a	3 15 17	7	09	0	0	0	0		82	09	2	7	7	9	32.5601	7
13-6.7b	3 15 17	7	09	6	0	0	0		82	09	2	7	7	9	32.5601	7
13-6.9	3 16 15	თ	09	6	0	0	0	0	82	09	2	<u>ი</u>	0	ω	32.5606	თ
13-6.10	3 16 16	10	09	0	0	0	0	0	2	09	7	10	10	0	32.5606	10

k = 13, Designs sorted based on minimizing Lmax

Design	wlp (w4,)	wlp		TO	alp			df		CZFI	Lmax	df	CZFI	Lmax	CD2*	CD2
		4									4	4117	Lailh	T AII Y		Tally
13-6.1	2 16 18		99	ဖ	0		0		1	99	2	-	Н	1	32.5558	-
13-6.2	16	7	99	9	0	0			85 (	99	2	7	2	2		2
13-6.3	3 12 24	ო	09	6	0		0 0			00	7	4	4	m	32.5589	m
13-6.4	3 14 17	4	09	თ	0					00	2	S	2	4		4
13-6.5	3 14 18	ഹ	09	σ	0		0 0			00	2	9	9	5	32.5597	S
13-6.7b	3 15 17	7	09	σ	0	0	0			0	2	7	7	9	32.5601	7
13-6.7a	3 15 17	7	09	σ	0		0			0	2	7	7	9	32.5601	7
13-6.9	3 16 15	6	09	თ	0		0			0	2	6	σ	œ		6
13-6.10	3 16 16	10	09	6	0	0	0			0	7	10	10	6	32.5606	10
13-6.11	3 17 15	11	09	6	0	0	0	80	2	0	7	11	11	10	32.5611	11

k = 13, Design generators

Generators	102	53 78 120	117	118	118	121	78	117	110	77		110	119	5 110	5 102	6 78	3 86	5 110	3 95	7 94
Design G	27 43	7 27 43 5	27 43	25 43	5 42	27 45	25 42	25 43	25 43	27 43	5 43	11 53	26 44	11 4	11 5	27 2	25 4	27 43	25 4	25 42
Design	13-6.1	13-6.2	13-6.3	13-6.4	13-6.5	13-6.6	13-6.7a	13-6.7b	13-6.9	-6.	13-6.11	13-6.12	13-6.13	13-6.14	Η.	13-6.16	13-6.17	۲.	13-6.19	.2

k = 14, Designs sorted based on word length pattern

Tank rank rank rank rank rank rank rank r	Ι.		1			1				2.	100	,	-	1			
73         9         0         96         73         2         1         1         29.3097           67         12         0         0         0         93         67         2         3         2         29.3138           64         12         0         0         0         0         91         64         3         4         33         29.3173           64         12         1         0         0         0         0         90         61         2         11         12         3         29.3173           64         12         1         0         0         0         0         90         61         2         11         13         4         29.3177           61         15         0         0         0         0         90         61         2         11         13         4         29.3181           64         12         1         0         0         0         90         61         2         13         15         6         29.3181           64         12         1         0         0         0         90         61         2         13<	w1p (w4,)		wip			al	Ω,			ä	CZFI		ar cank	czel rank	rank	CD2*	CD2 rank
67 12 0 0 0 0 0 93 67 2       2 3 29.3138         64 12 1 0 0 0 0 0 90 61 2 10       3 4 33 29.3173         61 15 0 0 0 0 0 90 61 2 10       3 4 5 34 29.3173         61 15 0 0 0 0 0 0 90 61 2 11       13 4 29.3177         61 15 0 0 0 0 0 0 90 61 2 11       13 4 29.3177         61 15 0 0 0 0 0 0 90 61 2 11       13 4 29.3177         64 12 1 0 0 0 0 0 90 61 2 11       13 4 29.3181         64 12 1 0 0 0 0 0 90 61 2 11       13 15 6 35 29.3181         64 12 1 0 0 0 0 0 90 61 2 13       15 6 35 29.3181         64 12 1 0 0 0 0 0 0 90 61 2 13       15 6 35 29.3181         61 15 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1		1	8					0	96	73	2			1	9.30	1
3 64 12 1 0 0 0 0 91 64 3 3 4 33 29.3173 3 61 15 0 0 0 0 0 90 61 2 10 12 3 29.3173 5 64 12 1 0 0 0 0 90 61 2 11 13 4 5 9.3177 5 61 15 0 0 0 0 0 90 61 2 11 13 4 29.3177 8 64 12 1 0 0 0 0 90 61 2 11 13 4 29.3177 8 64 12 1 0 0 0 0 90 61 2 11 13 4 29.3177 8 64 12 1 0 0 0 0 90 61 2 13 15 6 29.3181 8 61 15 0 0 0 0 0 90 61 2 13 15 6 29.3181 12 64 12 1 0 0 0 0 90 61 2 13 15 6 29.3181 13 64 12 1 0 0 0 0 90 61 2 13 15 6 29.3181 14 61 12 2 0 0 0 0 90 61 3 18 19 17 15 61 12 2 0 0 0 0 89 61 3 18 19 17 15 55 18 0 0 0 0 0 88 58 3 31 15 16 29 8 29.3207 15 55 18 0 0 0 0 0 87 55 2 51 69 8 29.3207 16 55 18 0 0 0 0 0 87 55 2 51 69 8 29.3208 19 55 18 0 0 0 0 0 87 55 2 51 10 29.3208 19 55 18 0 0 0 0 0 87 55 2 53 71 10 29.3208 19 55 18 0 0 0 0 0 0 87 55 2 53 71 10 29.3208	24		7	7					0	93	67	7	7	က	2	9,31	2
3 61 15 0 0 0 0 0 90 61 2 10 12 3 29.3173 5 64 12 1 0 0 0 0 90 61 2 11 13 4 5 34 29.3177 5 61 15 0 0 0 0 0 90 61 2 11 13 4 29.3177 8 64 12 1 0 0 0 0 90 61 2 11 13 4 29.3177 8 64 12 1 0 0 0 0 90 61 2 11 13 4 29.3177 8 64 12 1 0 0 0 0 90 61 2 11 13 4 29.3181 8 64 12 1 0 0 0 0 90 61 2 13 15 6 29.3181 8 61 15 0 0 0 0 0 90 61 2 13 15 6 29.3181 8 61 15 0 0 0 0 0 90 61 2 13 15 6 29.3181 12 64 12 1 0 0 0 0 90 61 2 13 15 6 29.3181 13 64 12 1 0 0 0 0 89 61 3 15 17 39 29.3198 14 61 12 2 0 0 0 0 89 61 3 16 18 40 29.3207 15 58 15 1 0 0 0 0 88 58 3 31 33 41 29.3207 15 55 18 0 0 0 0 0 87 55 2 51 69 8 29.3208 19 55 18 0 0 0 0 0 87 55 2 51 69 8 29.3208 19 55 18 0 0 0 0 0 87 55 2 53 71 10 29.3208 19 55 18 0 0 0 0 0 87 55 2 53 71 10 29.3208	5 22 30	_	М	4					0	91	64	n	m	4	33	9.317	m
5         64         12         1         0         0         91         64         3         4         5         34         29.3177           5         61         15         0         0         0         0         61         2         11         13         4         29.3177           8         61         15         0         0         0         0         90         61         2         11         13         4         29.3177           8         64         12         1         0         0         0         0         90         61         2         11         13         4         29.3177           8         64         12         1         0         0         0         90         61         2         13         15         6         35         29.3181           12         64         12         1         0         0         0         90         61         2         13         15         6         29.3181           12         64         1         2         13         15         6         29.3181           13         64         3         7	22 3	0	ĸ						0	90	61	2	10		m	9.31	m
5         61         15         0         0         0         61         2         11         13         4         29.3177           8         61         15         0         0         0         0         61         2         11         13         4         29.3177           8         61         15         0         0         0         0         91         64         3         5         6         35         29.3181           8         64         12         1         0         0         0         0         90         61         2         13         15         6         29.3181           8         61         15         0         0         0         0         0         90         61         2         13         15         6         29.3181           12         64         12         1         0	23 2	7	2	_					0	91	64	r	4	S	34	9.3	2
5       61 15       0       0       0       0       64 12       11       13       4       29.3177         8       64 12       1       0       0       0       0       91       64       3       5       6       35       29.3181         8       64 12       1       0       0       0       0       90       61       2       13       15       6       35       29.3181         8       61 15       0       0       0       0       0       0       90       61       2       13       15       6       29.3181         12       61 15       0       0       0       0       0       0       90       61       2       13       15       6       29.3181       1         12       64 12       1       0       0       0       0       0       0       0       3       8       3       3       29.3182       1         13       64 12       1       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0	23 2	7	5	П	_				0	90	61	2	11		4	9.3	5
8       64 12       1       0       0       0       91       64       3       5       6       35       29.3181         8       64 12       1       0       0       0       0       91       64       3       5       6       35       29.3181         8       64 12       1       0       0       0       0       0       90       61       2       13       15       6       29.3181         12       61 15       0        0       0       0       0       0       0       0       0       0       0       0       0       0       0       0        0       0       0       0	23 2	7	5	1		_		0	0	90	61	7	11		4	9.31	S
8       64 12       1       0       0       0       91       64       3       5       6       35       29.3181         8       61 15       0       0       0       0       90       61       2       13       15       6       29.3181         12       61 15       0       0       0       0       90       61       2       13       15       6       29.3181         12       64 12       1       0       0       0       0       91       64       3       8       37       29.3182       1         13       64 12       1       0       0       0       0       0       91       64       3       8       8       29.3182       1         14       61 12       2       0       0       0       0       0       0       0       3       15       17       39       29.3198       1         15       61 12       2       0       0       0       0       0       0       0       0       0       8       29.3207       1         15       55 18       0       0       0       0 <t< td=""><td>24 2</td><td>9</td><td>ω</td><td>П</td><td></td><td></td><td></td><td>0</td><td>0</td><td>91</td><td>64</td><td>m</td><td>Ŋ</td><td>9</td><td>35</td><td>9,31</td><td>Q</td></t<>	24 2	9	ω	П				0	0	91	64	m	Ŋ	9	35	9,31	Q
8     61     15     0<	24	9	80	4 1				0	0	91	64	က	Ŋ	9	35	9,31	0
8 61 15 0 0 0 0 0 0 0 61 2 13 15 6 29.3181 12 64 12 1 0 0 0 0 0 91 64 3 7 8 37 29.3182 1 13 64 12 1 0 0 0 0 91 64 3 8 9 38 29.3190 1 14 61 12 2 0 0 0 0 89 61 3 15 17 39 29.3198 1 15 61 12 2 0 0 0 0 88 58 3 31 83 41 29.3207 1 15 55 18 0 0 0 0 0 87 55 2 51 69 8 29.3207 1 19 55 18 0 0 0 0 87 55 2 53 71 10 29.3208 1 19 55 18 0 0 0 0 87 55 2 53 71 10 29.3208 1 19 55 18 0 0 0 0 87 55 2 53 71 10 29.3208 1		9	œ	П				0	0	90	61	7		15	9	9.31	80
12 64 12 1 0 0 0 0 91 64 3 7 8 37 29.3182 1 13 64 12 1 0 0 0 0 91 64 3 8 9 38 29.3190 1 14 61 12 2 0 0 0 0 89 61 3 15 17 39 29.3198 1 15 61 12 2 0 0 0 0 88 58 3 16 18 40 29.3207 1 15 55 18 0 0 0 0 0 87 55 2 51 69 8 29.3207 1 15 55 18 0 0 0 0 87 55 2 53 71 10 29.3208 1 19 55 18 0 0 0 0 87 55 2 53 71 10 29.3208 1 19 55 18 0 0 0 0 87 55 2 53 71 10 29.3208 1	24	9	ω					0	0	90	61	2		15	9	9.318	00
13       64       12       1       0	24	00	12	Н				0	0	91	64	က	7	<b>ω</b>	37	9.31	12
14     61     12     2     0     0     0     0     0     89     61     3     16     18     40     29.3207     1       15     61     12     2     0     0     0     0     0     88     58     3     31     33     41     29.3207     1       15     55     18     0     0     0     0     0     0     87     55     2     51     69     8     29.3207     1       15     55     18     0     0     0     0     0     87     55     2     53     71     10     29.3207     1       19     55     18     0     0     0     0     0     87     55     2     53     71     10     29.3208     1       19     55     18     0     0     0     0     0     0     0     0     23.3208     1	56	9	13	М				0	0	91	64	က	œ	6	38	9.31	13
15 61 12 2 0 0 0 0 89 61 3 16 18 40 29.3207 1 15 58 15 1 0 0 0 0 88 58 3 31 33 41 29.3207 1 1 15 55 18 0 0 0 0 0 87 55 2 51 69 8 29.3207 1 1 15 55 18 0 0 0 0 0 87 55 2 53 71 10 29.3207 1 1 19 55 18 0 0 0 0 87 55 2 53 71 10 29.3208 1 1 19 55 18 0 0 0 0 87 55 2 53 71 10 29.3208 1	17	0	14	П				0	0	89	61	က		17	39	9.31	14
15 58 15 1 0 0 0 0 88 58 3 31 33 41 29.3207 1 15 55 18 0 0 0 0 0 87 55 2 51 69 8 29.3207 1 1 15 55 18 0 0 0 0 0 87 55 2 51 69 8 29.3207 1 1 19 55 18 0 0 0 0 0 87 55 2 53 71 10 29.3208 1 1 55 18 0 0 0 0 0 87 55 2 53 71 10 29.3208 1 1 19 55 18 0 0 0 0 0 87 55 2 53 71 10 29.3208 1	20	œ	15	Н				0	0	89	61	ო		18	40	9.32	15
15 55 18 0 0 0 0 0 87 55 2 51 69 8 29,3207 1 15 55 18 0 0 0 0 0 87 55 2 51 69 8 29,3207 1 19 55 18 0 0 0 0 0 87 55 2 53 71 10 29,3208 1 19 55 18 0 0 0 0 0 87 55 2 53 71 10 29,3208 1	20 2	ω	15	8 1				0	0	88	28	က		33	41	9.3	15
15 55 18 0 0 0 0 0 87 55 2 51 69 8 29.3207 1 19 55 18 0 0 0 0 0 87 55 2 53 71 10 29.3208 1 19 55 18 0 0 0 0 0 87 55 2 53 71 10 29.3208 1	20 2	Ω	15	5 1				0	0	87	52	2		69	00	9.320	15
19 55 18 0 0 0 0 0 87 55 2 53 71 10 29,3208 1 19 55 18 0 0 0 0 0 87 55 2 53 71 10 29,3208 1	20 2	m	15	5 1				0	0	87	55	2	51	69	80	6	15
19 55 18 0 0 0 0 0 87 55 2 53 71 10 29,3208 1	20 3	0	19	5				0	0	87	55	7	53	71	10	6	19
	20 3	0	19	5 1	0		0	0	0	87	55	7	53	71	10	9.32	

k=14, Designs sorted based on degrees of freedom used

CD2* CD2 rank	3097 1	3138 2	3173 3	3177 5	.3181 9				3253 93	3173 3
	29.	29.	29.	29	29	29	29	29.	29.	29.
[ Lmax rank		2	č							
C2FI	1	ĸ	4	S	9	9	00			• •
x df rank		2	n	4	5	5	7		6	• •
Lma	2	7	n	n	m	m	n	n	က	2
C2FI Lmax		67								
df		93								
		0								
		0								
Ω		0								
alp		0	_	_	-	-1		-		0
		12 (	~	2		2				15
	ı	67 1								
wlp rank	H	7	m	2	∞	œ	12	13	94	m
(W4,)	36	30	30	27	26			26	21	30
wlp (w	3 24				5 24				7 21	
Design	14-7.1	14-7.2	14-7.3	14-7.5	14-7.8b	14-7.8a	14-7.12	14-7.13	14-7.94	14-7.4

k=14, Designs sorted based on the number of clear two-factor interactions

0 0 0 0 96 /3 2 1 1 1 29.5097 1 0 0 0 93 67 2 2 3 2 29.3253 93 0 0 0 91 64 3 3 4 33 29.3173 3 0 0 0 91 64 3 5 6 35 29.3181 9 0 0 0 91 64 3 5 6 35 29.3181 9 0 0 0 91 64 3 5 6 35 29.3181 9 0 0 0 91 64 3 5 6 35 29.3181 9 0 0 0 88 64 3 50 10 204 29.3296 216	rd CY-
0 0 91 70 3 9 2 98 29.3253 0 0 93 67 2 2 3 2 29.3138 0 0 91 64 3 4 5 34 29.3177 0 0 91 64 3 5 6 35 29.3181 0 0 88 64 3 50 10 204 29.3296	73
0 0 0 0 93 67 2 3 2 29.3138 0 0 0 0 91 64 3 3 4 33 29.3173 0 0 0 0 91 64 3 4 5 34 29.3177 0 0 0 0 91 64 3 5 6 35 29.3181 0 0 0 0 91 64 3 5 6 35 29.3181 0 0 0 0 91 64 3 5 6 35 29.3181 0 0 0 0 88 64 3 50 10 204 29.3296	
0 0 0 0 0 91 64 3 3 4 33 29.3173 0 0 0 0 91 64 3 4 5 34 29.3177 0 0 0 0 91 64 3 5 6 35 29.3181 0 0 0 0 91 64 3 5 6 35 29.3181 0 0 0 0 91 64 3 7 8 37 29.3182 0 0 0 0 88 64 3 50 10 204 29.3296	29
0 0 0 0 91 64 3 4 5 34 29.3177 0 0 0 0 91 64 3 5 6 35 29.3181 0 0 0 0 91 64 3 5 6 35 29.3181 0 0 0 0 91 64 3 7 8 37 29.3182 0 0 0 0 91 64 3 7 8 29.3190 0 0 0 0 88 64 3 50 10 204 29.3296	64
0 0 0 0 91 64 3 5 6 35 29.3181 0 0 0 0 91 64 3 5 6 35 29.3181 0 0 0 0 91 64 3 7 8 37 29.3182 0 0 0 0 91 64 3 8 9 38 29.3190 0 0 0 0 88 64 3 50 10 204 29.3296	5 64 12
0 0 0 0 91 64 3 5 6 35 29.3181 0 0 0 0 91 64 3 7 8 37 29.3182 0 0 0 0 91 64 3 8 9 38 29.3190 0 0 0 0 88 64 3 50 10 204 29.3296	64
0 0 0 0 91 64 3 7 8 37 29.3182 0 0 0 0 91 64 3 8 9 38 29.3190 0 0 0 0 88 64 3 50 10 204 29.3296	64
0 0 0 0 91 64 3 8 9 38 29.3190 0 0 0 0 88 64 3 50 10 204 29.3296	64
88 64 3 50 10 204 29.3296	64
	64

k = 14, Designs sorted based on minimizing Lmax

)esign	wlp(w4,)	wlp rank			U	alp				df (	CZFI	C2FI Lmax df rank	df rank	C2FI rank	Lmax rank	CD2*	CD2 rank
		1	73	6	0	0	0	0	0	96	73	2	-	1	F	29.3097	
	4 24 30	2	67	12	0	0	0	0	0	93	29	2	7	m	7	29,3138	2
		က	61	15	0	0	0	0	0	90	61	2	10	12	m	29.3173	m
	23	2	61	15	0	0	0	0	0	90	61	2	11	13	4	29.3177	S
14-7.6a		2	61	15	0	0	0	0	0	90	61	2	11	13	4	29.3177	S
14-7.10b	5 24 26	∞	61	15	0	0	0	0	0	90	61	7	13	15	9	29.3181	80
14-7.10a	5 24 26	∞	61	15	0	0	0	0	0	90	61	2	13	15	9	29,3181	∞

k = 14, Design generators

11-7 1								
	7	27	43	53	m	l_	30	
14-7.2	7	25	42	53	78	118 1	20	
14-7.3	7	11	29	23	₹	Δ1	50	
14-7.4	7	25	42	53	m	m	50	
14-7.5	7	11	29	49	C)	Δ1	02	
14-7.6a	7	25	42	53	Ŋ	87	50	
14-7.6b	7	25	42	53	Ŋ	118	50	
14-7.8a	7	11	29	46	3	102	50	
14-7.8b	7	11	29	49	4	102	50	•
14-7.10a	7	25	42	53	ω	93	50	
14-7.10b	7	25	42	09	7	118	50	
14-7.12	7	11	29	45	ω	118	50	
14-7.13	7	11	29	45	_	78	50	
14-7.14	7	27	29	46	ω	118	20	
14-7.15	7	Ξ	25	53	D	110	20	
14-7.16	7	11	29	53	9	102	20	
14-7.17a	7	25	42	53	9	86	20	
14-7.17b	7	25	42	53	9	102		
14-7.19a	7	25	42	53	3	92	20	
14-7.19b	7	25	42	61	ω	118	20	
14-7.94	7	27	45	78	$\vdash$	122	24	
14-7.216	7	27	43	82	4	101	20	

k = 15, Designs sorted based on word length pattern

Design	W1p (W4,)	wlp			100	alp				df 0	CZFI	Lmax	df	CZFI	Lmax	CD2*	CD2
		rank				•							rank	rank	rank		rank
	32 5	1	63		0	0	0			66	63	2	2	11	Н	26.3993	-
	34 4	2	63	21	0	0	0		0	66	63	2	n	12	7	26.3999	2
	7 38 44	e	69	15	7	0	0	0	0	101	69	က	Н	က	13		m
	31 5	4	57	24	0	0	0	_	0		57	7		73	m	26.4028	4
	32 4	S	57	24	0	0	0	_	0	96	57	7	29	74	4	26.4030	വ
	32 4	9	63	18	7	0	0	_	0	86	63	e	∞	13	14	26.4032	9
	32 4	9	57	24	0	0	0	-	0	96	57	2	30	75	S	26.4032	7
	33 4	<b>∞</b>	09	21	-	0	0		0	76	09	m	13	28	15	26.4034	∞
	33 4	6	99	15	ო	0	0	_	0	66	99	ო	4	4	16	26.4034	œ
	33	6	09	21	~	0	0	_	0	26	09	m	14		17	26.4034	∞
	33	11	09	21	Н	0			0	24	09	m	15	30	18		8
	(r)	11	57	24	0	0	0	0	0	96	57	2	31	97	9	26.4034	<b>∞</b>
	34	13	63	18	7	0			0	86	63	ო	6	14	19	26.4037	13
	34	13	09	21	~1	0			0	97	09	m	16	31	20		13
	34	13	9	21	Н	0			0	97	09	ო	16	31	20		13
	34	13	09	21	Н	0			_	26	09	m	16	31	20		13
	34	17	09	21	Н	0			0	97	09	က	19	34		26.4038	17
	34	18	99	15	ო	0			0	66	99	3	5	2	24	26.4038	17
	34	19	09	21	$\vdash$	0			0	26	09	ო	20	34	25	26.4039	19
	32	20	99	15	n	0			_	66	99	m	ø	9	26	26.4041	20

k = 15, Designs sorted based on degrees of freedom used

Design	wlp(w4,)	wlp rank			alp				df (	CZFI	C2FI Lmax r	df rank	C2FI rank	Lmax rank	CD2*	CD2 rank
15-8-3	7 38 44	8	- 1		0	0	0	0	101	69	3		3	13	26.4015	S.
15-8-1	5	· <del>- 1</del>	63 21	0	0	0	0	0	66	63	2	2	11	⊣	26.3993	1
15-8.2		2		0	0	0	0	0	66	63	2	က	12	2	26.3999	2
15-8.9		o م			0	0	0	0	66	99	m	4	4	16	26.4034	8
15-8.18	34	18		m	0	0	0	0	66	99	ო	S	ഹ	24	26.4038	17
15-8.20	35	20		ന	0	0	0	0	66	99	m	9	9	26	26,4041	20
15-8-1221	28	1221		0	7	0	0	0	66	77	4	7	г	1366	26.4245	1226
15-8.6		9			0	0	0	0	86	63	က	80	13	14	26.4032	9
15-8.13	34	13	63 18	2	0	0	0	0	86	63	က	თ	14	19	26.4037	13
15-8.22b	36	22			0	0	0	0	86	63	Э	10	16	28	26.4045	22

k=15, Designs sorted based on the number of clear two-factor interactions

Design	Wlp (W4,)	wlp			alp	Qι			d£ (	CZFI	df C2FI Lmax	df	CZFI	Lmax	CD2*	CD2
		rank										rank	rank	rank		Lalin
15-8 1221	14 28 28	1221	l	0	,	0	0		66	77	4	7	7	1366	26.4245	1226
15-8-1578	28	1578	71	m		0	0	0	96	71	4	57	7	1615	26.4284	1593
15-8-3	38	m			2	0	0		101	69	ന	~	m	13	26.4015	က
15-8-9		0			3	0			66	99	m	4	4	16	26.4034	∞
15-8-18	34	18	66 1		3	0	0		66	99	က	വ	2	24	26.4038	17
15-8.20	35	20			ر س	0			66	99	m	9	9	26	26.4041	20
15-8.152		152			7	0	0	0	97	99	κ	27	7	148	26.4106	153
15-8.303		303			9	0	0	0	96	65	4	53	∞	933	26.4137	303
15-8.344	11 31 34	344	65	6	9	0	0	0	96	65	4	52	0	940	26.4141	352
15-8.358	11 32 34	358			9	0	0	0	96	65	4	56	10	944	26.4145	363

k=15, Designs sorted based on minimizing Lmax

Design	wlp (w4,)	wlp rank		10	alp				df (	ZEI	C2FI Lmax	df rank	C2FI rank	Lmax rank	CD2*	CD2 rank
5-8.1	7 32 52	П	1	0	0	0	0	0	66	63	2	2	11	-	26.3993	1
15-8.2	7 34 46	2	63 21	0	0	0	0	0	66	63	2	m	12	2	26.3999	2
15-8.4	8 31 50	4		0	0	0	0	0	96	57	7	28	73	m	26.4028	4
5	8 32 44	ß		0	0	0	0	0	96	57	7	29	74	4	26.4030	5
15-8.7	8 32 49	9		0	0	0	0	0	96	57	7	30	75	S	26.4032	7
15-8.12	8 33 44	11		0	0	0	0	0	96	57	2	31	97	9	26.4034	∞
15-8.26	9 28 48	26		0	0	0	0	0	93	51	2	144	357	7	26,4054	25
15-8.31	9 30 46	27	51 27	0	0	0	0	0	93	51	7	145	358	œ	26.4062	30
15-8.45	9 32 42	41		0	0	0	0	0	93	51	2	146	359	6	26.4069	41
5-8.214	11 20 60	214	39 33	0	0	0	0	0	87	39	7	831	1742	10	26.4104	149

k = 15, Design generators

α <u>-</u> υ	7	25	42	53	78		]-		
15-8.2		25	42	23	75	87 1	116	120	
5-8	7	11	29	45	51	~	18		
5-8.	7	25	42	53	62	78	~~		
5-8	7	25	42	53	75	_			
5-8	7	11	29	46	53	~	07		
5	7	25	42	53	62	78	٠,		
5-8.	7	11	29	45	62	81	~		
5-	7	11	25	45	20		10		
5-8.1	7	11	29	46	49	Λ1	~1		
7	7	11	29	46	49	Δ1	60		
5-8.1	7	25	42	52	63	11			
5-8.1	7	11	25	45	52		$\overline{}$		
5-8.1	7	11	29	45	62	81	~		
5-8.1	7	11	29	46	49	m	02		
5-8.1	7	11	29	46	49	m	60		
5-8.1	7	11	29	45	62	_	50		
5-8.1	7	11	25	42	53	m	18		
5-8.1	7	11	59	46	53	m	94		
5-8.2	7	11	25	45	49	to	$\overline{}$		
5-8.2	7	11	29	45	51	m	98		
5-8.2	7	25	42	52	77	o	~		
5-8.3	7	25	42	52	63	11	S		
5-8.4	7	25	42	52	63	7	07		
5-8.1	7	11	13	30	49	N	01		
5-8.2	7	25	42	52	77	9	19		
5-8.3	7	11	19	25	45	7	18		
5-8.3	7	11	19	25	45	9	00		
5-8.3	7	11	19	25	45	7	10		
15-8.1221	7	27	45	78		N	4		
5-8 157	7	27	۲ ۷	α	V	0	C		

k = 16, Designs sorted based on word length pattern

Design	wlp (w4,)	wlp				alp				df	C2FI	Lmax	df	C2FI	Lmax	CD2*	CD2
		rank				ı						-	rank	rank	rank		rank
6-9	48	1	60 30		0	0	0	0	0	106	09	2	2	24	-	23.7778	-
-6-	1 44 8	7	54 33		0	0	0	0	0	103	54	8	24	3	2	3	2
1	11 47 72	m	57 30	-	0	0	0	0	0	104	57	m	12	102	9	•	က
6-9	48 7	4			0	0	0	0	0	104	57	n	13	0	7	3	4
1	20 6	5			0	0	0	0	0	105	09	m	e	25	8		2
1	20 6	9			0	0	0	0	0	105	09	ო	4	26	σ	3.7	9
6	1 52 6	7	2		0	0	0	0	0	105	09	က	2	27	10	23.7826	8
1	1 56 6	<b>c</b> c			0	0	0	0	0	107	99	m	Н	9	11	23.7842	16
9	2 40 8	6	48 36		0	0	0	0	0	100	48	7	168	896	m	3.7	7
9	Φ	10	60 24		0	0	0	0	0	104	09	m	14	28	12	3.784	6
-9	2 46 6	10	7		0	0	0	0	0	103	57	က	25	104	13	23.7840	6
9	46 6	10	4		0	0	0	0	0	102	54	m	20	239	14	3.7	თ
6	466	10	4		0	0	0	0	0	102	54	ო	20	239	14	23.7840	6
-9.1	466	14	4	7	0	0	0	0	0	102	54	m	52	241	16	23.7840	13
6-9.1	2 46 6	14	4	2	0	0	0	0	0	102	54	٣	52	241	16	23.7840	13
1	2 46 6	14		Н	0	0	0	0	0	101	51	m	102	535	18	23.7840	13
9	2 47 6	17	~	4	0	0	0	0	0	104	9	m	15	29	19	23.7843	17
-9.1	2 47 6	17	0	4	0	0	0	0	0	104	9	m	15	29	19	23.7843	17
6-9.1	2 47 6	17	7 2	m	0	0	0	0	0	103	57	ო	56	105	21	23.7843	17
16 - 9.19b	47 6	17	7	m	0	0	0	0	0	103	27	m	26	105	21	23.7843	17

k = 16, Designs sorted based on degrees of freedom used

)esign	W1p (W4,)	wlp			10	alp				df (	C2FI Lmax		df	CZFI	Lmax	CD2*	CD2
		rank										-1	Alla	raiir	raiiv		1
16-9.8	56	8	66 21	4	0	0	0	0	0	10.7	99	3	1	9	11		16
		Н		0	0	0	0	0	0	106	09	2	2	24	Н	23.7778	<del></del> 1
0	11 50 66	S		7	0	0	0	0	0	105	09	ო	m	25	ω		5
16-9.6	20	9	60 27	7	0	0	0	0	0	105	09	m	4	26	σ	23.7819	9
16-9.7	52	7		7	0	0	0	0	0	105	09	m	വ	27	10	23.7826	8
16-9.35	20	35	63 21	Ŋ	0	0	0	0	0	105	63	က	9	11	37	23.7854	37
16-9.39	12 52 63	39		2	0	0	0	0	0	105	63	က	7	12	41		40
16-9.80		80	65 18	Ŋ	Н	0	0	0	0	105	65	4	∞	7	803	23.7875	80
16-9.90	47	90	65 18	2	Н	0	0	0	0	105	65	4	6	∞	908	23.7878	91

k=16, Designs sorted based on the number of clear two-factor interactions

Design	wlp (w4,)	wlp rank			-	alp				df (	CZFI	C2FI Lmax df rank	df rank	C2FI rank	Lmax rank	CD2*	CD2 rank
16-9.1413	17 43 56	1413	9 69		m	0	0	0	0	103	69	4	46	П	1551	23.8004	1446
16-9.2469	19 40 50	2469	69 11	0	9	Н	0	0	0	103	69	Ŋ	47	2	4905	23.8062	2578
16-9.2499	19 41 48	2499	69 11	0	9	Н	0	0	0	103	69	5	48	က	4911	23.8065	2647
16-9.2531	19 42 48	2531	69 11	0	9	Н	0	0	0	103	69	വ	49	4	4917	23.8069	2696
16-9.225	14 46 61	225		Ŋ	7	0	0	0	0	105	29	4	11	S	842	23.7909	232
16-9.8		ω	66 21	4	0	0	0	0	0	107	99	m	Н	9	11	23.7842	16
16-9.80		80	65 18	S	Н	0	0	0	0	105	65	4	œ	7	803	23.7875	80
16-9.90	13 47 64	90	65 18	5	H	0	0	0	0	105	65	4	თ	ω	908	23.7878	91

k = 16, Designs sorted based on minimizing Lmax

Design	wlp (w4,)	wlp rank				alp				df	C2FI	C2FI Lmax df rank	k df rank	C2FI rank	Lmax rank	CD2*	CD2 rank
16-9.1	10 48 72	H	60 30	0	0	0	0	0	0	106	09	2	2	24	-	23.7778	-
16-9.2	11 44 82	7	54 33	0	0	0	0	0	0	103	54	2	24	238	2	23.7802	2
16-9.9	12 40 80	0	48 36	0	0	0	0	0	0	100	48	2	168	896	m	23.7822	7
16-9.287	30	287	30 45	0	0	0	0	0	0	91	30	2	2383	5641	4	23.7897	142
16-9.2604	20 0 160	2604	09 0	0	0	0	0	0	0	97	0	2	6195	7485	വ	23.7982	1042
16-9.3	47	က		~	0	0	0	0	0	104	57	٣	12	102	9	23.7810	e
16-9.4		4		Н	0	0	0	0	0	104	57	က	13	103	7	23.7813	4
16-9.5	11 50 66	S	60 27	7	0	0	0	0	0	105	09	က	m	25	<b>©</b>	23.7819	5
16-9.6	11 50 68	9		7	0	0	0	0	0	105	09	က	4	26	6	23.7819	9
16-9.7	11 52 66	7	60 27	7	0	0	0	0	0	105	09	ĸ	2	27	10	23.7826	<b>o</b> o
		:															

k = 16, Design generators

1										
.6-0		000	25	42	53	75	1		118	A CONTRACT OF THE PROPERTY OF
16-9.2	7 12	0,1	25	42	53	62	78	83	92	
5-9.	Н	0.2	11	29	45	51	78			
5-9.	Н	20	11	29	45	51	78		100	
5-9.	$\vdash$	20	11	29	45	51	78		0	
5-9.	Н	20	11	29	45	51	78		$\vdash$	
5-9.	Н	50	11	29	45	51	62	78	$\infty$	
5-9.	Н	50	11	29	45	51	23	78	118	
5-9.	$\vdash$	20	25	42	52	11		107	~	
5-9.1	Н	50	11	21	46	54	83	95	66	
5-9.1	-	20	11	21	41	51	78	98	100	
5-9.1		20	11	29	45	49	78	86	0	
5-9.1	П	20	11	21	45	62	98	91	97	
5-9.1	-	20	11	29	45	53	78	81	86	
5-9.1		20	11	25	45	51	78	90	0	
6-9.1	-	20	11	29	45	51	78	81	$\circ$	
6-9		20	11	21	45	98	91	97	103	
6-9.1	-	20	11	25	45	49	11	82	_	
6-9.1		20	11	21	41	51	78	93	$\circ$	
6-9.1		20	11	21	41	28	11	91		
6-9.3	_	20	11	25	45	20	09	98	$\overline{}$	
6-9.3		20	11	25	45	49	63	86	~	
8-6-9	_	20	11	19	29	41	44	94	$^{\circ}$	
6-6-9	1	20	11	19	41	44	23	78	$\Box$	
6 - 9.22	_	20	11	19	25	41	53	78	$\overline{}$	
6-9.28	43	20	25	42	61	17	83	95	$\circ$	
6 - 9.141	•	20	11	19	25	28	45	11	•	
6 - 9.246		20	11	19	25	26	45	77		
6 - 9.249	٠.	20	11	19	25	26	45	86	$\sim$	
6-9.2	٠.	20	11	19	25	26	45	11	110	
6-9.260	•		10	20	77	n O	0	č	_	

k=17, Designs sorted based on word length pattern

Tank rank rank rank rank rank rank rank r	2 2
0         0         108         46         2         53         1594         1         21.4231           0         0         110         52         3         6         390         3         21.4245           0         0         110         52         3         1         62         5         21.4251           0         0         112         58         3         1         62         5         21.4253           0         0         107         46         3         106         1594         6         21.4273           0         0         107         46         3         106         1594         6         21.4273           0         0         109         52         3         22         392         8         21.4273           0         0         108         49         3         54         835         9         21.4273           0         0         110         55         3         22         393         11         21.4275           0         0         110         55         3         12         13         21.4284         1           0 </th <th></th>	
0         0         110         52         3         6         390         3         21.4245           0         0         110         52         3         7         391         4         21.4245           0         0         112         58         3         106         1594         6         21.4273           0         0         100         55         3         22         392         8         21.4273           0         0         109         52         3         22         392         8         21.4273           0         0         109         52         3         22         392         8         21.4273           0         0         109         52         3         9         153         10         21.4273           0         0         109         52         3         15         11         21.4273           0         0         110         55         3         10         21.4273           0         0         111         58         3         22         393         11         21.4278           0         0         111         58<	6 45 0
0         0         110         52         3         7         391         4         21.4251           0         0         112         58         3         1         62         5         21.4263           0         0         107         46         3         106         1594         6         21.4273           0         0         109         52         3         22         392         8         21.4273           0         0         108         49         3         54         835         9         21.4273           0         0         110         55         3         22         393         11         21.4275           0         0         110         55         3         10         11.4278         1           0         0         111         58         3         1         21.4278         1           0         0         111         58         3         1         21.4284         1           0         0         111         58         3         1         21.4284         1           0         0         110         55         3	
0         0         112         58         3         1         62         5         21.4263           0         0         107         46         3         106         1594         6         21.4273           0         0         110         55         3         22         392         8         21.4273           0         0         108         49         3         54         835         9         21.4273           0         0         109         52         3         22         393         11         21.4273           0         0         110         55         3         10         21.4275         1           0         0         110         55         3         10         154         12         21.4275           0         0         111         58         3         13         21.4275         1           0         0         111         58         3         11         155         14         21.4281         1           0         0         110         55         3         12         14284         1           0         0         110	2 39 2 0 0
0       107       46       3       106       1594       6       21.4270         0       0       110       55       3       22       392       8       21.4273         0       0       109       52       3       22       392       8       21.4273         0       0       108       49       3       54       835       9       21.4273         0       0       110       55       3       22       393       11       21.4275         0       0       110       55       3       10       154       12       21.4275         0       0       111       58       3       2       63       13       21.4275         0       0       111       58       3       1       155       14       21.4281       1         0       0       110       55       3       12       156       16       21.4284       1         0       0       110       55       3       12       156       16       21.4284       1         0       0       108       51       4       55       525       365	3 3 3 4 0
0     0     110     55     3     8     152     7     21.4273       0     0     109     52     3     22     392     8     21.4273       0     0     108     49     3     54     835     9     21.4273       0     0     110     55     3     22     393     11     21.4275       0     0     110     55     3     10     154     12     21.4276       0     0     111     58     3     2     63     13     21.4281     1       0     0     111     58     3     11     155     14     21.4281     1       0     0     110     55     3     12     156     16     21.4284     1       0     0     110     55     3     12     156     16     21.4284     1       0     0     108     51     4     55     525     365     21.4284     1       0     0     108     51     4     55     525     365     21.4284     1       0     0     109     55     3     24     157     18     21.4296     1<	6 42 2 0 0
0     0     109     52     392     8     21.4273       0     0     108     49     3     54     835     9     21.4273       0     0     110     55     3     22     393     11     21.4275       0     0     110     55     3     10     154     12     21.4275       0     0     111     58     3     2     63     13     21.4281     1       0     0     111     58     3     11     155     14     21.4281     1       0     0     110     55     3     12     156     16     21.4284     1       0     0     110     55     3     12     156     16     21.4284     1       0     0     108     51     4     55     525     365     21.4284     1       0     0     108     51     4     55     525     365     21.4284     1       0     0     109     55     3     24     157     18     21.4296     1       0     0     109     55     3     24     157     18     21.4300     1	5 33 5 0 0
0 0 108 49 3 54 835 9 21.4273 0 0 110 55 3 9 153 10 21.4275 0 0 109 52 3 22 393 11 21.4275 0 0 110 55 3 10 154 12 21.4278 0 0 111 58 3 2 63 13 21.4281 0 0 111 58 3 64 15 21.4281 0 0 110 55 3 12 156 16 21.4284 0 0 108 51 4 55 525 365 21.4295 0 0 109 55 3 24 157 18 21.4300 0 0 108 51 4 56 526 366 21.4300 0 0 108 51 4 56 526 366 21.4300 0 0 109 55 3 25 158 19 21.4301	2 36 4 0 0
0 0 110 55 3 9 153 10 21.4275 0 0 109 52 3 22 393 11 21.4275 0 0 110 55 3 10 154 12 21.4278 0 0 111 58 3 2 63 13 21.4281 0 0 111 58 3 11 155 14 21.4281 0 0 110 55 3 12 156 16 21.4284 0 0 108 51 4 55 525 365 21.4295 0 0 109 55 3 24 157 18 21.4300 0 0 108 51 4 56 526 366 21.4300 0 0 108 51 4 56 526 366 21.4300 0 0 108 51 4 56 526 366 21.4300 0 0 109 55 3 25 158 19 21.4301	9 39 3 0 0
0 109 52 3 22 393 11 21.4275 0 110 55 3 10 154 12 21.4278 0 111 58 3 2 63 13 21.4281 0 110 55 3 11 155 14 21.4281 0 110 55 3 12 156 16 21.4284 1 155 16 21.4284 1 17 21.4284 1 18 21.4295 1 19 55 3 24 157 18 21.4300 1 108 51 4 56 526 366 21.4300 0 109 55 3 25 158 19 21.4300 1 108 51 4 56 526 366 21.4300 1 109 55 3 25 158 19 21.4301	5 33 5
0 110 55 3 10 154 12 21.4278 1 0 111 58 3 2 63 13 21.4281 1 0 110 55 3 11 155 14 21.4281 1 0 111 58 3 3 64 15 21.4284 1 0 108 51 4 55 525 365 21.4284 1 0 109 55 3 24 157 18 21.4300 1 0 109 55 3 25 158 19 21.4300 1 0 109 55 3 25 158 19 21.4300 1	2 36 4 0 0
0 111 58 3 2 63 13 21.4281 1 0 110 55 3 11 155 14 21.4281 1 1 0 110 55 3 11 155 14 21.4281 1 1 0 110 55 3 12 156 16 21.4284 1 1 0 108 51 4 55 525 365 21.4296 1 0 109 55 3 24 157 18 21.4300 1 0 109 55 3 25 158 19 21.4301 2	33 5 0 0
0 110 55 3 11 155 14 21.4281 1 0 111 58 3 3 64 15 21.4284 1 0 110 55 3 12 156 16 21.4284 1 0 108 51 4 55 525 365 21.4295 1 0 109 55 3 24 157 18 21.4300 1 0 109 55 3 25 158 19 21.4300 1 0 109 55 3 25 158 19 21.4301 2	3 30 6 0 0
0 111 58 3 3 64 15 21.4284 1 0 110 55 3 12 156 16 21.4284 1 0 108 51 4 55 525 365 21.4295 1 0 109 55 3 24 157 18 21.4300 1 0 109 55 3 25 158 19 21.4301 2	33 5
0 110 55 3 12 156 16 21.4284 1 0 108 51 4 55 525 365 21.4295 1 0 107 49 3 107 836 17 21.4296 1 0 109 55 3 24 157 18 21.4300 1 0 108 51 4 56 526 366 21.4300 1 0 109 55 3 25 158 19 21.4301 2	30 6 0 0
0 108 51 4 55 525 365 21.4295 1 0 107 49 3 107 836 17 21.4296 1 0 109 55 3 24 157 18 21.4300 1 0 108 51 4 56 526 366 21.4300 1 0 109 55 3 25 158 19 21.4301 2	33 5 0 0
0 107 49 3 107 836 17 21.4296 1 0 109 55 3 24 157 18 21.4300 1 0 108 51 4 56 526 366 21.4300 1 0 109 55 3 25 158 19 21.4301 2	36 3 1 0
0 109 55 3 24 157 18 21.4300 1 0 108 51 4 56 526 366 21.4300 1 0 109 55 3 25 158 19 21.4301 2	36 5 0 0
0 108 51 4 56 526 366 21.4300 1 0 109 55 3 25 158 19 21.4301 2	30 7 0 0
0 109 55 3 25 158 19 21.4301 2	. 36 3 1 0
	30 7 0 0

k=17, Designs sorted based on degrees of freedom used

CD2	Lalik	4	12	14	1091	2680	2	m	9	6	11
CD2*		21.4263	21.4281	21.4284	21.4419	21.4475	21.4245	21.4251	21.4273	21.4275	21.4278
Lmax	rank	5	13	15	6454	6685	က	4	7	10	12
CZFI	rank	62	63	64	4	വ	390	391	152	153	154
	rank	<b>-</b> -1	7	m	4	വ	9	7	∞	0	10
C2FI Lmax		3	m	က	5	5	က	က	က	က	က
CZE		58	58	28	89	89	52	52	55	52	55
ďĘ		112	111	111	111	111	110	110	110	110	110
		0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0
0		0	0	0	0	0	0	0	0	0	0
alp		0	0	0	Н	7	0	0	0	0	0
		0	0	0	2	2	0	0	0	0	0
		4	9	9	g	0	2	7	2	2	2
		33	30	30	14	19	39	39	33	33	33
		58	28	28	89	89	52	52	55	52	55
wlp	rank	4	12	14	1042	2453	2	m	9	ത	11
4,)		102									101
Wlp (W4,)		15 72	16 68	16 69	21 62					16 66	16 67
Design		17-10.4	17-10.12	17-10.14	17-10.1042	17-10.2453	17-10.2	17-10.3	17-10.6	17-10.9	17-10.11

k=17, Designs sorted based on the number of clear two-factor interactions

Design	wlp (w4,)	wlp rank				alp				df C2	FI	C2FI Lmax	df rank	C2FI rank	Lmax rank	CD2*	CD2 rank
17-10.5924	27 56 82	5924	75 3	ω	4	m	0	0	0 1	10 7	5	5	21	-1	7888	21.4589	6713
17-10,12633	39 44 86	12633			12	0	m	0	0 1(	7 20	0	6 1,	412	2	13402	21.4938	13276
17-10.6792	28 55 77	6792	9 69	∞	4	m	0	0	0 10	07 69	0	5	202	m	8264	21.4617	7580
17-10.1042	62	1042	68 14	6	7	۲	0	0	0 1.	111 68	ω	5	4	4	6454	21.4419	1091
17-10.2453	23 60 86	2453	68 19	0	Ŋ	7	0	0	0 1.		<b>ω</b>	5	2	Ŋ	6685	21,4475	2680
17-10.6795a	55	6795	9 99	. 6	10	0	0	0	0 10		9	4	516	9	4750	21.4617	7626
17-10,6795b	55	6795	9 99	9	10	0	0	0	0 1		99	4	516	9	4750	21.4617	7626
17-10.7585a	29 52 76	7585	9 99	g	4	m	0	0	0 10		9	2	518	∞	8654	21.4638	8165
17-10.7585b	29 52 76	7585	9 99	0	4	m	0	0	0 1		99	J.	518	ω	8653	21.4638	8165

k = 17, Designs sorted based on minimizing Lmax

Design	wlp (w4,)	wlp rank			100	alp			df		C2FI Lmax	df rank	C2FI rank	Lmax rank	CD2*	CD2 rank
17-10.1	15 60 130	1	46 45	0	0	0			108		2	53	1594	-	21.4231	۲
17-10.315	40	315	16 60	0	0	0	0	0					12479	2	21,4333	105
17-10.2	15 66 110	2	52 39	2	0	0		0	1	0 52	က	9	390	က	21.4245	2
17-10.3	89	m		7	0	0						7	391	4	21.4251	m
17-10.4	15 72 102	4	58 33	4	0	0	0	0			m	1	62	2	21,4263	4
17-10.5	64	S	46 42	7	0	0		0	10.	7 46	က	106	1594	9	21.4270	5
17-10.6	65	9	55 33	S	0	0	0	0	110	55	က	<b>o</b> o	152	7	21.4273	9
17-10.7	65	9	52 36	4	0	0	0	0	10		٣	22	392	∞	21,4273	9
17-10.8	16 65 107	œ	49 39	m	0	0	0	0 0	108		m	54	835	6	21.4273	8
17-10.9	99	6	55 33	Ŋ	0	0	0	0 0	11(	55	က	O	153	10	21.4275	6

k = 17, Design generators

7-10.		2		3 6	1	8	92	99	N	
7-10.		Ч	o.	5		∞	100		$\sim$	
7-10.		-	ത	5		7	81	100	$^{\circ}$	
7-10.		Н	ıO	5		7	84	σ	$\sim$	
7-10.		П	0	5		∞	106	$\vdash$	$\sim$	
7-10.		7	1	5 6		თ	26	0	$\sim$	
7-10.		⊣	_	1 5		0	110	$\vdash$	$^{\circ}$	
7-10.			2	5		7	84	0	$\sim$	
7-10.		7	Н	8		∞	111	7	$\sim$	
-10.1		1	5 4	5		∞	86	118	$^{\circ}$	
7-10.1		<del>,  </del>	$\vdash$	1 5		7	93	0	$^{\circ}$	
7-10.1		$\vdash$	Н	5		∞	97	0	$^{\circ}$	
7-10.1		7	Ч	8		ω	110	۲	$\sim$	
7-10.1		7	П	5		O)	97	0	$\sim$	
7-10.1		<del></del> 1	$\vdash$	5		7	86	σ	$\sim$	
7-10.1		$\vdash$	9	1 5		Φ	110	7-1	$\alpha$	
7-10.1		⊣	⊣	1 5		_	98	0	120	
7-10.1		7	<del>- 1</del>	8		ω	108	$\vdash$	$\sim$	
7-10.1		-	9	-1		ω	0		$\alpha$	
7-10.2		1	1	-1		7	84	0	$^{\prime\prime}$	
7-10.31	7 2	25 4	12 6	1 7	7 83	95	66	108	120	
7-10.104		-	თ	5		4	86	$\overline{}$	()	
7-10.2		<del></del>	თ	5		u)	78	$\vdash$	120	
7-10.592		-	თ	5		4	77	$\vdash$	$\alpha$	
7-10,679		Н	m	6		4	82	0	$\alpha$	•
7-10.6795		_	m	6		4	78	98	(1)	
7-10.6795		_	m	9		4	78	-	()	
7-10.7585		Н	3	6		u,	82		(1	
7-10.7585		Н	m	9		u,	86	110	(1	
7-10.764			3	6		4	78		120	
0701 01 1		,	c	Ľ		ζ,	7	ζ	C	

k = 18, Designs sorted based on word length pattern

Design	wlp (w4,	<u></u>	wlp				ıa	alp				df C	C2FI ]	Lmax	df	C2FI	Lmax	CD2*	CD2
			rank											н	ank	rank	rank		rank
18-11.1	0	00	1	33 60	0	0	0	0	0	0		111	33	2	209 1	10601	П	19,3048	-
18-11.2	0	0	7	5 4	3 4	0	0	0	0	0		115	45	က	7	1464	7	19,3074	2
18-11.3	21 95 1	48	က	54 36		0	0	0	0	0	0	117	54	٣	Н	124	m	19,3109	m
18-11.4	1 9	-	4	4 3		0	0	0	0	0			54	٣	2	125	4	19.3112	4
18-11.5	2 8	2	5	2 4		0	0	0	0	0			42	က	91	2702	S	9.3	ഹ
	2	50	9	1 3	Н	0	0	0	0	0			51	ო	80	260	9	19,3123	9
18-11.7	2	50	9	8		0	0	0	0	0		114	48	က	24	693	7		9
18-11.8	2	46	<b>&amp;</b>	1 3	3 10	0	0	0	0	0		115	51	m	თ	261	00	9.31	10
18-11.9	2	46	œ	0 3		Н	0	0	0	0		115	50	4	10	363	69	9.31	10
18-11.10a	0	46	10	3	8	Н	0	0	0	0			53	4	S	155	70	9.31	<b>∞</b>
	2	46	10	3		1	0	0	0	0			53	4	വ	155	70	19.3128	<b>∞</b>
	2	48	12	0 3		H	0	0	0	0		115	50	4	11	364	72	19.3128	12
	2	48	12	0			0	0	0	0			50	4	11	364	72	19.3128	12
8-11.1	3 86	54	14	8	111		0	0	0	0		113	48	m		694	0	19.3141	14
:	3 86	54	14	4			0	0	0	0			44	4	92	1836	74	19.3141	14
-11.1	8	48	16	0 3		Н	0	0	0	0	0	114	50	4	25	9	75	19.3145	16
-11.1	ω ω	48	16	ж ж	11	0	0	0	0	0	0	113	48	r	53	695	10	19.3145	16
-11.1	ω ω	œ	16	7 3		Н	0	0	0	0	0	113		4	53	2	97	19.3145	
18-11.19	ထ	48	16	3.4		2	0	0	0	0	0	112		4	93	2259	77	19,3145	19
18-11.20	8	50	20	1 3	Н	0	0	0	0	0	0	114	51	ო	56	9	11	19.3146	

k=18, Designs sorted based on degrees of freedom used

CD2 rank	3	4	6205	16763	ω	∞	2	9	10	10
CD2*	19,3109	19.3112	19.3377	19,3583	19,3128	19.3128	19.3074	19.3123	19.3128	19,3128
Lmax rank	3	4	18580	20088	70	70	2	9	∞	69
C2FI rank	124	125	5	1 2	155	155	1464	260	261	363
k df rank	1	2	m	4	വ	വ	7	∞	9	10
Lma	3	m	9	9	4	4	m	c	က	4
C2FI Lmax	54	54	71	81	53	53	45	51	51	20
df	117	117	117	117	116	116	115	115	115	115
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
alp	0	0	Н	m	0	0	0	0	0	0
	0	0	7	0	0	0	0	0	0	0
	0	0	4	12	Н	Н	0	0	0	H
	6	თ	ω	0	ω	ω	4	10	10	7
	36	36	13	m	36	36	48	36	36	39
	54	54	71	81	53	53	45	51	51	20
wlp rank	3	4	5146	14398	10	10	2	9	∞	∞
-	148	151	132			146	160	150	46	46
W4r.	95 1	96 1	80 1	72 1	92 1		92 1		_	92 1
wlp (w4,)	21 9		32 8						22 9	
Design	18-11.3	18-11.4	18-11.5146	18-11.14398	18-11.10b	18-11.10a	18-11.2		18-11.8	18-11.9

k=18, Designs sorted based on the number of clear two-factor interactions

Design	W1D (W4,)	мТр					alp	۵			df C	C2FI Lmax	Lmax	df	CZFI	Lmax	CD2*	CD2
		rank						ı						rank	rank	rank		rank
18-11.14398	40 72 124	14398		6	0 1	0	3	0	0	0	117	81	9	4	-	20088	19,3583	16763
18-11.15397a	41 71 120	15397		9	1 9	9 6	0	0	0	0	112	72	S	206	7	13773	19,3608	17757
18-11.15397b	41 71 120	15397		9	-	9	0	0	0	0	112	72	Ŋ	206	8	13773	19,3608	17757
18-11,16125	42 72 112	16125		9	1	2	m	0	0	0	112	72	9	208	4	20598		18906
18-11.5146	80	5146	71 1	13	8 4	4		0	0	0	117	71	9	m	വ	18580	19,3377	6205
18-11.15386	70	15386		6	0		0	0	0	0	111	69	Ŋ	372	9	13769		17304
18-11.23841a	56 56 140	23841	69	m	0	Н	m	0	0	0	105	69	9	3057	7	23076		24353
18-11.23841b	56 56 140	23841	69	က	0	0 12	m	0	0	0	105	69	9	3057	7	23076	19.4004	24352
18-11.5147	32 80 132	5146	66	14	9	9	0	0	0	0	114	99	5	48	0	7496	19.3377	6205
18-11.6397	79	6397		14	0	3 4	0	0	0	0	114	99	2	20	10	8258	19.3402	7583

k = 18, Designs sorted based on minimizing Lmax

Design	Wlp (W4,)	wlp				TO TO	alp				df	C2FI	C2FI Lmax	df	CZFI	Lmax	CD2*	CD2
		rank											н	rank	rank	rank		rank
18-11.1	80	н	33 60	0	0	0	0	0	0	0	111	33	2	209 1	10601		19.3048	-
18-11.2	92	7	45 48	3 4	0	0	0	0	0	0	115	45	m	7	1464	2	19,3074	2
18-11.3	92	က	54 36	9	0	0	0	0	0	0	117	54	٣	Н	124	ĸ	19.3109	m
18-11.4	96	4	54 36	9	0	0	0	0	0	0	117	54	m	2	125	4	19,3112	4
18-11.5	86	Ŋ	42 45	5 7	0	0	0	0	0	0	112	42	т	91	2702	ഗ	19,3114	5
18-11.6	22 90 150	9	51 36		0	0	0	0	0	0	115	51	т	œ	260	9	19,3123	9
18-11.7	90	9	48 39		0	0	0	0	0	0	114	48	e	24	693	7	19,3123	9
18-11.8	92	∞	51 36	5 10	0	0	0	0	0	0	115	51	m	0	261	œ	19,3128	10
18-11.14	98	14	48 36	5 11	0	0	0	0	0	0	113	48	٣	51	694	σ	19.3141	14
18-11.17	23 88 148	16	48 36	5 11	0	0	0	0	0	0	113	48	٣	53	695	10	19.3145	16

k = 18, Design generators

	11 12	01 12	03 12	18 12	12	18 12	18 12	18 12	18 12	18 12	01 12	12	00 12	18 12	18 12	16 12	07 12	18 12	06 12	3 12	10 12	18 12	09 12	10 12	03 12	00 12	18 12	17 12	78 120	5 12
	66	σ	97	110	o)	111	101	11	66	111	91	01	92	106	110	106	101	106	102	101	86	78	82	17	92	78	78	77	28 46	7
	0	ω	ω	σ	∞	ത	ത	∞	ω	∞	ω	ω	ω	01	ω	Oi	ω	ω	ω	ω	4		7	7.	7.	7	7	7	26 28	
ators	_	۵,	٥1	. 1	~			~	<u></u>	m		ω.	m	ω.	m		m	0	m	က	ന	D.	ဖ	ထ	2	Ŋ	Ŋ	ω	25 2	2
Generat				_		_	_	_	~	_	_	~	~	Φ.	_	m	m	7	_	m	(O	_	LO	G		_	Н.	9	21	$\vdash$
ign G	53	45	45	42	41	38	38	41	41	29	38	41	41	38	29	29	25	38	29	25	25	19	19	25	19	19	19	25	19	19
Des	42	25	21	25	21	21	21	21	19	19	19	19	19	21	19	19	21	19	19	21	19	13	13	19	13	13	13	19	13	13
	25	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Design	1-11.	1-11.	3-11.	3-11.	3-11.	3-11.	3-11.	3-11.	3-11.	3-11.1	3-11.10	3-11.1	3-11.12	3-11.1	3-11.1	3-11.1	3-11.1	3-11.1	3-11.1	3-11.2	3-11.514	3-11.514	8-11.639	8-11.1439	8-11.153	8-11,1539	8-11.153	8-11.1612	18-11.23841a	8-11.2384

k = 19, Designs sorted based on word length pattern

Design	wlp(w4,)	wlp				"	alp			df	CZFI	Lmax	df	C2FI	Lmax	CD2*	CD2
		rank											rank	rank	rank		rank
-12.	7 120 23	Н	6 54	1		0	0	0	0	1	36	3	22	5807	H	7.40	
-12.	28 122 220	7	45 42 1	4 0	0	0	0	0	0	120	45	m	m	681	7	17.4091	7
1	0 110 24	က	2 51 1	7		0	0	0	0	-	32		387 1	1	80	7.41	m
-12.	0 114 22	4	2 39 1	7		0	0	0	0		42	e	52	1582	m	7.41	5
9-12.	0 116 22	വ	0 45 1	П		0	0	0	0	П	40	4	53	u,	0	7.41	9
7	0 118 21	9	5 36 1	ω		0	0	0	0	$\vdash$	45	٣	23	682	4	.41	7
9-12.	0 118 21	7	36 1	9		0	0	0	0	-	47	4	10	384	10	41	7
19-12.8	0 118 21	7	4 39 1	2		0	0	0	0	118	44	4	24	937	11	7.41	7
9-1	0 118 2	6	9 1			0	0	0	0	7	44	4	25	938	12	7.4	10
7	0 120 21	10	51			0	0	0	0	119	42	4	11	1583	13	41	11
9-1	0 121 20	11	7 36 1			0	0	0	0	$\vdash$	47	4	12	385	14	7.41	12
9-1	0 122 20	12	0 33 1			0	0	0	0	$\sim$	50	4	5	170	16	7.4	13
9-1	0 122 20	12	6 45			0	0	0	0	$\sim$	46	4	4	517	15	7.414	13
9-1	1 100 27	14	Н			0	0	0	0	Н	30		970 1	51	2	7.41	4
9-12.1	1 116 21	15	3 39 1			0	0	0	0	117	43	4	54	$\sim$	17	7.415	15
9-1	1 116 21	16	6 36 1			0	0	0	0	$\vdash$	46	4	26	518	18	7.41	16
9-1	1 116 21	16	0 42 1			0	0	0	0	116	40		0	2541	19	7.415	16
9-1	1 116 21		0 42 1			0	0	0	0	Н	40	4 1	0	S	19	415	16
9-12.	1 116 21		0 30 1			0	0	0	0	119	50	4	13	171	21	7.415	19
9-1	31 117 210	20	6 36 1			0	0	0	0	ш	46	4	27	519	22	17.4153	20
19-12.20b	1 117 21		6 36 1			0	0	0	0	٦	46	4	27	519	22	7.415	20

k = 19, Designs sorted based on degrees of freedom used

Design	wlp(w4,)	wlp rank					alp	Q,				df C	C2FI Lmax		df rank	C2FI rank	Lmax rank	CD2*	CD2 rank
19-12.12482	46 102 193	102 192 12482	- 1	15	0	12	0	2		0	0 1	123	74	7	1	1 .	35208	17.4498	16695
19-12,6923	42 106 200	0 6923	70	∞	17	7	4	$\leftarrow$	0	0	0 1	121	70	9	7	7	22319	17.4407	9180
19-12.2	28 122 22	0 2	45	42	14	0	0	0	0	0	0 1	.20	45	ო	ო	681	7	17.4091	2
19-12.13	30 122 208	8 12	46	45	വ	2	0	0	0	0	0 1	20	46	4	4	517	15	17.4140	13
19-12.12	122	8 12	50	33	17	Н	0	0	0	0	0 1	.20	20	4	S	170	16	17.4140	13
19-12.161	33 117 19	8 161	53	32	11	4		0	0	0	0 1	.20	53	S	9	91	2587	17.4202	164
19-12.3218		7 3218	59	26	თ	4	Н	7	0	0	0 1	120	59	9	7	39	21728	17.4353	5406
19-12.12483		2 12482	69	16	Н	σ	2	⊣	0	0	0	20	69	Q	ω	ω	24025	17.4498	16695
19-12,14059		7 14059	89	18	0	12	0	2	٦	0	0 1	120	89	7	<u>ه</u>	11	35317	4518	18094
19-12.7	30 118 214	4 7	47	36	16	Н	0	0	0	0	0 1	119	47	4	10	384	10	17.4131	7

k = 19, Designs sorted based on the number of clear two-factor interactions

Design	wlp(w4,) wlp	wlp rank					alp				df C	C2FI Lmax	max	df rank	C2FI	Lmax rank	CD2*	CD2 rank
19-12,26380a 58 90 184	58 90 184	26380	78	6 1	0	12	m	0	0	0	119	78	9	20	-	29308	17.4777 3	33773
19-12.26380b	58 90 184	26380	78	6	0	12	m	0	0	0	119	78	9	20	⊣	29308	17.4777 3	33773
19-12.12482	46 102 192 12482	12482	74 15	5	12	0	2	1	0	0	123	74	7	ᆏ	m	35208	17,4498 1	16695
19-12.38700	78 70 224	38700	74	0 8	0	0	14	٦	0	0	111	74	7 1	1911	4	38310	17.5257 3	38922
19-12.31264	62 86 164	31264		7	0	12	က	0	0	0	113	72	9	896	വ	30857	17,4865 3	36481
19-12.31266	62 90 160	31266	72 (	7	0	12	n	0	0	0	113	72		696	9	30858	17.4875 3	36579
19-12,6923	42 106 200	6923	70	8 17	(/)	4	Н	0	0	0	121	70	9	2	7	22319	17.4407	9180
19-12,12483	46 102 192	12482	69	6 1	S)	5	Н	0	0	0	120	69	9	ω	∞	24025	17.4498 1	16695
19-12.27425	59 86 182	27425	69 12	2	0	12	n	0	0	0	115	69	9	386	0	29630	17.4792 3	34647

k = 19, Designs sorted based on minimizing Lmax

Design	WLD (W41)	wlp rank					ιŊ	alp			J	df C	CZFI	Lmax	df rank	C2FI rank	Lmax rank	CD2*	CD2 rank
19-12.1	27 120 235	Н	- 1 .	54	0	0	0	0	0	0	0	18	36	m	22	5807	-	17.4063	
19-12.2	28 122	2	45	42	14	0	0	0	0	0	0 12	120	45	m	m	681	7	17,4091	2
19-12.4	30 114	4	42	39	17	0	0	0	0	0	0 13	17	42	ო	52	1582	m	17.4123	ഗ
19-12.6	30 118	9		36	18	0	0	0	0	0	0 11	18	45	٣	23	682	4	17.4131	7
19-12.14	31 100	14		48	15	0	0	0	0	0		12	30	e	970 1	15112	2	17.4121	4
19-12.640	36 90	640		18	30	0	0	0	0	0	0 11	12	45	m	1053	722	9	17,4219	299
19-12.18529		18529		18	45	0	0	0	0	0	0	32	0	3 27		39241	7	17.4415	9659
19-12.3	110	m	32	51	11	Н	0	0	0	0	0 1.	14	32	4		11720	ω	17.4115	က
19-12.5		Ŋ	40	45	11	2	0	0	0	0	0 13	17	40	4	53	2540	6	17.4127	9
19-12.7	118	7	47	36	16	Н	0	0	0	0	0 13	119	47	4	10	384	10	17.4131	7

11 7 11 21 41 2 7 11 21 38 4 7 11 21 38 5 7 11 19 38 6 7 11 19 38 8 7 11 19 38 8 7 11 19 38 9 7 11 19 38 10 7 11 19 38 11 7 11 19 29 11 7 11 19 29 11 7 11 19 29 12 7 11 19 29 13 7 11 19 29 14 7 11 19 29 16 8 7 11 19 29 16 9 7 11 19 29 16 9 7 11 19 29 17 10 10 29 18 10 20 18 10 20	54 58 58 58 58 58 58 58 58 58 58 58 58 58	8 79 66 83 83 83 83 83 83 83 83 83 83 83 83 83	86 90 10 90 10 90 10 90 10 90 90 90 90 90 90 90 90 90 90 90 90 90	992 1 001 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	100 100 100 100 100 100 100 100 100 100	1 120 8 120 6 120 6 120 6 120 7 120 1 120 9 120 0 120 0 123
2		8		0001 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		70 10 10 10 10 10 10 10 10 10 10 10 10 10
3 7 11 19 3 6 6 7 11 19 3 7 6 6 7 11 19 3 7 7 11 19 3 7 7 11 19 3 7 7 11 19 3 7 7 11 19 3 9 7 7 11 19 3 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0			00000000000000000000000000000000000000		70 10 10 10 10 10 10 10 10 10 10 10 10 10
4 7 11 21 3 6 6 7 11 19 3 7 7 11 19 3 7 7 11 19 3 9 7 7 11 19 3 9 9 7 7 11 19 3 9 9 9 7 7 11 19 2 10 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	6	147160888887600808		001 1 0095 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		70 10 10 10 10 10 10 10 10 10 10 10 10 10
5 7 11 19 3 7 7 11 19 3 7 7 11 19 3 9 8 8 7 7 11 19 3 9 9 9 7 7 11 19 3 9 9 9 7 7 11 19 3 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0 L 0 0 C C C C C C C C C C C C C C C C	7 8 7 7 8 8 8 8 8 8 7 7 8 8 7 7 8 8 8 8	10 10 TH 10 TH TH TH TH 10 10 CO TH	00000111111111111111111111111111111111	100110111111111111111111111111111111111	70 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
6 7 11 21 3 3 9 9 7 11 19 3 9 9 9 7 11 19 3 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9		8		001 1 9999 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		12 12 12 12 12 12 12 12 12 12 12 12 12 1
7	0 0 C C C C C C C C C C C C C C C C C C	7 7 2 3 3 3 3 3 7 7 7 7 9 9 9 9 7 7 7 9 9 9 9		999 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	110010010010010001000000000000000000000	3 12 3 12 7 12 12 12 12 12 12 12 12 12 12 12 12 12 1
8 7 11 19 3 11 10 11 10 11 11 11 11 11 11 11 11 11	000000000000000000000000000000000000000	7.000007780000		999 1 884 1 1 6 8 8 8 7 1 6 8 8 8 7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	11 10 11 11 11 11 11 11 11 11 11 11 11 1	122 122 122 123 123 123 123 123 123 123
9 7 11 21 2 11 10 3 11 11 11 11 11 11 11 11 11 11 11 11 1	200000000000000000000000000000000000000	200001741		884 1 887 1 1 882 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	110011	7 12 1 12 1 12 1 12 1 12 1 12 1 12 1 12
10 7 11 19 3 11 11 12 12 13 14 14 17 11 19 2 14 15 17 11 19 2 14 15 17 11 19 2 17 11 11 11 11 11 11 11 11 11 11 11 11	27777777	00001740000		887 1 882 882 992 992 111 1	100000	1 12 3 12 3 12 1 12 1 12 1 12 1 12 1 12
111 7 111 19 2 113 7 111 19 2 114 7 111 19 2 115 7 111 19 2 116 7 111 19 3 116 7 111 19 3 117b 7 111 19 2 119 7 111 19 2 120a 7 111 19 2 161 7 11 19 2 1640 7 11 19 2 12482 7 11 19 2 12482 7 11 19 2 12483 7 11 19 2 12483 7 11 19 2 12483 7 11 19 2 12483 7 11 19 2 18529 7 11 19 2	7111777 8888888	14 57 69 83 89 89 89 89 89 89 89 89 89 89 89 89 89	~ ~ ~ 10 10 C M	882 882 992 111 1	100101	1001007
112 7 11 19 2 14 15 11 15 2 14 15 11 19 2 16 17 11 19 2 16 17 11 19 3 17 11 19 2 17 17 11 19 2 17 17 17 17 17 17 17 17 17 17 17 17 17	111077	11 55 60 7 7 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	m m 10 10 0 m 1	882 982 111 84 1	1010	12217
13 7 11 19 2 16 11 15 11 15 11 15 11 15 11 15 11 16 17 11 11 15 11 17 11 17 11 11 15 11 15 11 15 15 15 15 15 15 15	11	0 1 2 8 9 7 7 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	m 10 10 0 m	882 92 111 111 111	100000000000000000000000000000000000000	12 12 12 13 14 15 15 15 15 15 15 15 15 15 15 15 15 15
14 7 11 21 4 15 7 11 19 3 16 7 11 19 3 16 7 11 19 3 17a 7 11 21 2 17b 7 11 19 2 20a 7 11 19 2 20b 7 11 19 2 640 7 11 19 2 640 7 11 19 2 12482 7 11 19 2 12482 7 11 19 2 12483 7 11 19 2 12483 7 11 19 2 18529 7 11 19 2	70 0 1 4 4 4 4 4	7 6 6 6 7 6 7 6 7 6 7 6 7 6 7 6 7 6 7 6	10 10 0 m	92 92 111 1	9 10	1 12 3 12 0 12 12 12
115 7 11 19 3 16 17a 7 11 19 3 17b 7 11 21 21 21 21 21 22 20a 7 11 19 2 20b 7 11 11 11 11 11 11 11 11 11 11 11 11 1	0 1 4 5 4 4 4 4	C 0 1 C 4 1	10 0 m	92 11 11 84 1	9 11	3 12 0 12 7 12
116 7 11 21 3 17a 17b 7 11 21 2 2 19 2 19 2 20a 7 11 19 2 20b 7 11 19 2 12482 7 11 19 2 12483 7 11 19 2 18529 7 11 19 2 18529 7 11 19 2 2053809 7 11 19 10 10 10 10 10 10 10 10 10 10 10 10 10		01741	- m	111 1 84 1		0 12
17a 7 11 21 2 20a 7 11 19 2 20a 7 11 19 2 20b 7 11 19 2 205 3 218 7 11 19 2 12482 7 11 19 2 14059 7 21 28 3 26380a 7 11 14 1 1	40.4444	1 4 7 1	78	44.1	3 12	7 12
17b 7 11 19 2 20a 7 11 19 2 20b 7 11 19 2 20c 20c 20c 20c 20c 20c 20c 20c 20c 2	0 0 0 0 0 0 0 4 4 4 4 4	7 4 1	4	4	10	
20a 7 11 21 2 20b 7 11 19 2 20c 20c 20c 20c 20c 20c 20c 20c 20c 2	4444	1 5	73	7	5 11	8 12
20a 7 11 19 2 20b 7 11 19 2 2161 7 11 19 2 2640 7 11 19 2 23218 7 11 19 2 212482 7 11 19 2 212483 7 11 19 2 218529 7 21 28 3	444	1 6	77	3.1	111	8 12
20b 7 11 19 2 640 7 11 19 2 33218 7 11 19 2 6923 7 11 19 2 12482 7 11 19 2 14059 7 11 19 2 14059 7 11 19 2 18529 7 11 19 2 18529 7 11 19 2 18529 7 11 19 2 18529 7 11 19 2 18529 7 11 19 2 18529 7 11 14 1 1	8 9		69	1 1	5 11	6 12
161 7 11 19 2 3218 7 11 19 2 3218 7 11 19 2 6923 7 11 19 2 12482 7 11 19 2 14059 7 11 19 2 18529 7 21 28 3	5	7	73	5	3 11	8 12
540 7 11 21 3 3218 7 11 19 2 6923 7 11 19 2 12482 7 11 19 2 12483 7 11 19 2 14059 7 11 19 2 18529 7 21 28 3 3 5380a 7 11 14 1 1		1	73	7 1	2 10	8 12
3218 7 11 19 2 6923 7 11 19 2 12482 7 11 19 2 12483 7 11 19 2 14059 7 11 19 2 18529 7 21 28 3	7	8 9	93	8 1	7 11	8 12
6923 7 11 19 2 12482 7 11 19 2 12483 7 11 19 2 14059 7 11 19 2 18529 7 21 28 3	9	(r) @	45	6	3 11	8 12
12482 7 11 19 2 12483 7 11 19 2 14059 7 11 19 2 18529 7 21 28 3	9	ω	45	0	6 11	0 12
12483 7 11 19 2 14059 7 11 19 2 18529 7 21 28 3	9	(r) &	35	Ω	6 11	0 12
14059 7 11 19 2 18529 7 21 28 3	5	9	35	2	6 11	0 12
18529 7 21 28 3	9	80	35	2	7 11	8 12
7 11 14 1	4	6	81	8	2 12	1 12
T ET TT / BOOCOT	5	9	31	2	7 11	0 12
26380b 7 11 14 1	5	9	31		7 11	7 12
27425 7 11 13 1	1	2	56		2 10	3 12
31264 7 11 13 1	1	2	26		8 11	8 12
31266 7 11 19 2	5	9	31		7 11	7 12
38700 7 27 43 5	9	5	88	Γ,	4 11	2 12

k=20, Designs sorted based on word length pattern

CD2	raiiv	1	2	e	m	S	S	7	<b>∞</b>	6	10	12	13	11	16	14	14	17	17	19	20	20	
CD2*		5.69	5.704	5.705	10	5.707	5.707	5.708	5.7	15.7082	.70	.708	.708	15.7085	15.7097	.70		.71	5.7	5.710	5.710	5.7	
Lmax	raily	1	2	m	4	9	5	7	<b>∞</b>	g	10	485	11	12	13	15	14	486	16	17	18	19	
CZFI	Taily	28084	715	1032	1929	5165	11873	3164	1501	1033	1502	9924	1034	7874	716	3165	4168	415	1503	1504	190	3166	
df	לווא	111	9	11	26	_	111	54	27	12	28	29	13	230	30	115	-	14	52	52	15	57	
Lmax	•	4	4	4	4	4	4	4	4	4	4	5	4	4	4	4	4	5	4	4	4	4	
CZFI		24	41	40	38	34	30	36	39	40	39	31	40	32	41	36	35	43	39	39	46	36	
df (			11	(1	121		-	(1	(1	(1)	121	$\alpha$	$\alpha$	Н	121	Н	П	$^{\circ}$	$\sim$	120	122		
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Ωı		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
alp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	-1	0	0	0	0	
		1	7	ო	7	m	7	4	4	9	4	m	9	2	2	な	2	m	4	4	m	7	
		14	21	20	22	20	œ		19	14	19	4	14	9	19	50	17	0	11	11	9	7	
		0	თ	σ	39	0	54	2	6	0	6				9					9	7		
		4	-	0	ω	4	0	9	6	0	0	Н	0	c)	41	ဖ	35 '		6	39		9	
wlp														3	14			7	7		0	0	
	,	40	10	80	308	16	16	80	00	86	86	96	00	12	301	01	01	94	94	95	96	96	
( W4 ,		2	9	$\sim$	2	ω	$\infty$	2	3	4	4	9	9	4	0	0	0	2	2	2 2	0	2 2	
wlp (w4,)		-	Н	Н	9 15	Н	Н	Н	Н	15	-	_		П	. 15	۲.	. 15	. 15	. 15	. 15	15	15	
13		3(	38	χ,	3	4(	40	4	40				40	41	41	41	41	41	41	41	41	41	
Design		20-13.1	7	Ħ	•	-	0-1	0-13.	0-13.	0-1	0 - 13.1	-13.1	0 - 13.1	0-1	0 - 13.1	7	0 - 13.1	0 - 13.1	0 - 13.1	٦.	20-13.20	20-13.21	

k = 20, Designs sorted based on degrees of freedom used

CD2 rank	30523	55382	12963	61	23100	2	74	73
CD2*	15.7578		15.7390		.7491		.7131	15.7131
Lmax rank	47887	51633	45588	497	46802	7	501	502
C2FI rank	4	Н	13	191	Ŋ	715	64	1933
df rank	₽	7	ന	4	S	9	7	ω
df C2FI Imax df rank	7	7	7	Ŋ	7	4	IJ	വ
C2FI	72	84	59	46	70	41	20	38
df	126	126	125	124	124	123	123	123
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
Ωı	-	_	7	0	m	0	0	0
alp	2	14	$\vdash$	0	0	0	0	0
	- 1	0		m	0	0	H	2
			12	m	12	7	0	7
	rH	-			13			ო
	18	9			9			55
	72	84	59	46	70		20	38
wlp rank	23128	80 112 280 47458	7545	58	16206	38 156 310 2	62	62
	80	083	266	284	272	310	286	286
wlp(w4,)	28 2	12 2	148 2		32 2	56 3	156 2	156 2
1p (1	4 12	0	4 1,	42 15	0 1.	8	2 1.	42 15
	20-13.23128 64 128 280 23128	47458 80			206			
Design	20-13.	20-13.47458	20-13.7545	20-13.58	20-13,16206	20-13.2	20-13.62	20-13.63

k=20, Designs sorted based on the number of clear two-factor interactions

)esign	wlp(w4,)	<u></u>	wlp rank						alp					df C	df C2FI Lmax df rank	Lmax		-	C2FI Lmax rank rank	CD2*	CD2 rank
7458	80 112	280	47458		و		0	0	4		0	0	0	126	84	7	2		51633	15.7915	55382
2497	20-13,52497 84 108 256 52497	256	52497	78	0	7	0	0	4	$\vdash$	0	0	0	120	78	7	110	7	52866	15,7993	56241
0328	82 108	270	50328	75	0	7	0	0	4	Н	0	0	0	121	75	7	53	m	52274	15.7950	55770
3128	64 128	280	23128		18	Н	0	12	7	$\vdash$	0	0	0	126	72	7	$\leftarrow$	4	47887	15.7578	30523
6206	60 132	272	16206	70		13	12	0	0	m	0	0	0	124	70	7	വ	<sub>R</sub>	46802	15,7491	23100
20-13.57639	108 84	336	57639			-1	0	0	0	15	0	0	0	112	70	7	3369	9	55270	15.8520	57809

k = 20, Designs sorted based on minimizing Lmax

Design	wlp (w4,)	wlp					10	alp				df C	C2FI Lmax	max	df	C2FI	Lmax	CD2*	CD2
		rank												н	rank	rank	rank		rank
20-13.1	152	0 1	24 6	50 14	1	0	0	0	0	0	0	119	24	4	111	28084	-	15.6994	r-1
20-13.2	156	0 2	41 3	19 21	7	0	0	0	0	0	0	123	41	4	9	715	2		2
20-13.3	152	8	40 3	9 20	٣	0	0	0	0	0	0	122	40	4	11	1032	m	15,7056	m
20-13.4	39 152 308	8	38 39		7	0	0	0	0	0	0	121	38	4	26	1929	4	15.7056	m
20-13.6	148	6 5	30 5		7	0	0	0	0	0	0	119	30	4	111 1	11873	S	15.7072	2
20-13.5	148	6 5	34 4	2 20	m	0	0	0	0	0	0	119	34	4		5165	9	15.7072	വ
20-13.7	152	8 7	36 4		4	0	0	0	0	0	0	120	36	4	54	3164	7	15.7080	7
20-13.8	153	8 0	39 3	9 19	4	0	0	0	0	0	0	121	39	4	27	1501	ω	15.7080	∞
20-13.9	154	8	40 4	2 14	9	0	0	0	0	0	0	122	40	4	12	1033	9	15.7082	6
20-13.10	154	6	39 3	9 19	4	0	0	0	0	0	0	121	39	4	28	1502	10		10

	2	2	$\sim$	2	$^{\circ}$	$^{\circ}$	$^{\circ}$	$\sim$	$^{\circ}$	120	$^{\circ}$	$^{\circ}$	$\sim$	$\sim$	$\sim$	120	$\alpha$	$^{\circ}$	$\alpha$	$\alpha$	CA	$^{\circ}$	CA	(V	O	(A	w	CA	CA	(1	(1
	120	$\vdash$	$\vdash$	-	$\vdash$	$\circ$	0	0		$\leftarrow$	$\vdash$	0	$\vdash$	$^{\circ}$	$\vdash$	107	$\vdash$	$\vdash$	-		-	-	O1	100		$\neg$	$\neg$	-	$\circ$	$\Box$	1
	0	0	$\vdash$	-	0	0	0	0	$\vdash$	106	$\vdash$	ത	106	$\leftarrow$	$\overline{}$	101	O)	$\circ$	$\vdash$	П	101	$\circ$	95	92	86	86	86	11	78	77	112
	66	101	66	66	92	95	84	93	101	91	101	94	101	111	66	84	92	66	66	85	87	102	82	82	53	59	45	45	46	45	104
	92	92	93	92	82	82	78	84	90	82	93	91	95	90	82	82	82	92	73	74	74	84	78	78	45	45	35	31	31	31	66
	98	82	84	82	73	73	28	78	83	73	84	52	82	83	73	78	73	82	70	59	61	74	63	63	35	35	31	28	26	28	88
!	79	73	73	73	09	09	52	28	9/	09	73	49	73	9/	09	28	09	81	9	52	52	62	53	53	31	31	28	26	25	26	83
	58	70	09	09	27	57	41	52	57	57	41	47	09	63	57	41	57	73	57	41	49	22	41	41	28	28	26	25	22	25	75
	54	09	22	21	38	38	38	38	38	38	35	41	57	57	38	38	38	59	38	38	41	41	30	26	26	26	25	22	21	21	26
1	41	38	38	38	29	19	25	25	21	29	30	29	38	38	29	25	19	38	29	30	30	29	29	25	25	25	21	19	19	19	51
1	21	21	19	19	19	14	21	21	13	19	19	19	19	21	19	21	13	21	19	19	19	19	19	19	19	19	49	14	13	14	43
	11	11	11	11	11	11	11	11	11	11	11	11	13	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	27
	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
116.1.611	0-13.	0-13.	0-13.	0-13.	0-13.	0-13.	0-13.	0-13.	0-13.	0-13.1	0 - 13.1	0-13.1	0-13.1	0 - 13.1	0-13.1	20-13.16	0 - 13.1	0 - 13.1	0 - 13.1	0 - 13.2	0 - 13.2	0 - 13.5	0-13.6	0-13.6	0 - 13.754	0 - 13.1620	0 - 13.2312	0 - 13.4745	0 - 13.5032	0 - 13.524	0 - 13.5763

k = 21, Designs sorted based on word length pattern

CD2	rank	2	m	Н	4	2	7	œ	6	9	10	10	12	13	13	15	16	18	17	19	22	20
CD2*		4.175	۲.	14.1753	.17	4.177	14.1772	14.1774	14.1780	14.1772	14.1781	14.1781	.17		.178	.178	.178	.179	14.1791	14.1795	14.1799	14.1796
Lmax	rank	45	1	2	46	47	m	4	48	8560	S	9	7	49	20	8561	51	52	80		8562	
CZFI	rank	781	10484	518	5419	01	15	88	വ	85	36	93	93	36	8257	15	$\vdash$	4	36	8258	34	93
df	rank				57		6	10	1	1698	26	58	27	28	120	11	12	9	29	59	30	121
Lmax		5	4	4	2	2	4	4	Ŋ	9	4	4	4	ഗ	2	9	S	5	4	2	Q	2
CZFI		26	28	24	31	33	36	35	36	ω	34	32	32	34	29	36	37	41	34	29	20	32
df		123	123	120	122	$^{\circ}$	$^{\circ}$	61	127	_	123	$\mathcal{C}^{\prime}$	123	$^{\prime\prime}$	121	$\sim$	124	$^{\circ}$	123	122	123	121
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
alp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	-	0	0	0	0	0	Н	0	0	0	0	m	0
		m	0	0	Н	Н	0	0	9	0	0	0	0	7	Н	0	Н	m	0	Н	0	Ч
		4	11	σ	5	9	σ	10	0	7	11	10	13	Ŋ	7	9	∞	4	11	10	7	7
		15	12	18	26	24	22	19	16	12	18	20	12	24	22	24	22	24	18	14	0	25
		54	51	48	38	38	36	39	48	99	39	39	45	37	41	36	35	33	39	47	72	35
		26	28	24	31	33	36	35	36	∞	34	32	32	34	29	36	37	41	34	29	20	32
wlp	Lalik				4						-	П	-	Н	-		16	17	17	19	20	21
		414	400	452	420	112	116	102	100	140	122	122	112	113	113	105	401	404	404	395		438
W4.		00	2	4	4	9	96	$\infty$	$\vdash$	4	0	0	$\sim$	m	$^{\circ}$	マ	2	٥	ဖ	<u>ი</u>	0	86 4
wlp (w4,			51 2	2	52 1	2 1	2 1	2	2	3 1	3 1	3 1	3 1	3 1	3 1	3 1	3 1	3.1	3 1	3 1	3	
Design		21-14.1	21-14.2	21-14.3			21-14.6	21-14.7	21-14.8	21-14.9	1-14.1	1-1	1 - 14.1	1-14.1	1-14.1	1 - 14.1	21-14.16	1-14.1	21-14.18	1-14.1	21-14.20	21-14.21

k=21, Designs sorted based on degrees of freedom used

Design	wlp	wlp (w4,)	$\overline{}$	wlp rank					alp					df	CZFI	C2FI Lmax df rank	df rank	C2FI rank	Lmax rank	CD2*	CD2 rank
21-14.8	52	201	201 400	ω	36	- 1	16	0	0	0	0	0	0	127		5	-	1157	48	14.1780	6
21-14.110	26	189	392	110	56	0 4	<u></u>			1	0	0	0	12.		7	7	∞	51208	14.1836	113
21-14.2560	64	181		2560	62	0	37	9 0	5		0			12.		7	က	m	51401	14.1986	4100
21-14.23744	80	165		CA	72	0	19							12.		7	4	2	56822		7684
21-14.80683			392		84					15				15.		7	5		74585		82077
21-14 17	53.1		404		41		24							12(			9	240	52	14.1791	18
21-14 225	57		196 376	225		30 2								12		9	7	79		14.1869	331
21-14 7379	. 69	196	364	7									0	12		∞	∞	10	75434	14.2121	16832
21-14-6	52	196	416		36		22 9		0		0			124	4 36	4	0	1156	m	14.1772	7
21-14.7	52	198		7	35	39 1		10 (	0 0	0	0	0	0	12,		4	10	1882	4	14.1774	ω

k=21, Designs sorted based on the number of clear two-factor interactions

Design	W L	( , w) n (w	Z M						ala				O	df C21	T	C2FI Lmax df		CZFI	Lmax	CD2*	CD2
	4	· · · · · · · · · · · · · · · · · · ·	rank						1							rank		rank	rank		rank
21-14 80683	112	133 392		84	C	7	0	0	0 15	2	0	0	12	7 8	4	7	5	-	74585 1	14.2896	82077
21-14 23744	2 0	165 392			0	19	0	12	0	ر س	0	)	127	7 72	α	7	4	2	56822 1	14.2290	37684
21-14.2560	9 6	181 392	2560		0	37	0	9	0		0	0	) 127	7 62	2	7	ო	m	51401 1	14.1986	4100
21-14 18122	77	164 404			6	9	19	0	9	0	0	)		3 62	2	9	26	4	17698 1	14.2227	28548
21-14 41505	. 6	148 372		62	17	9	-	0	14	0	· H	0			2	8	119	2	77854 1	14.2523	74961
21-14 38737	000	148 380			20	9	0			0	, H	0		2 60	0	8 1.	118	9	17767	14.2503	73985
21-14 29904	2 0	153 384			00	17	_	13	0	m	0	0	0 119	.9 57	7	7 6.	617	7	58605 1	14.2346	51023
21-14 110	יש	189 392			0	49	0	0	0	-	0	0	127		56	7	7	8	51208 1	14.1836	113
21-14 28450	0 00	153 391	~	55	12	14	~	12	0	m	0	0	0 119	Ŋ	5	7 6]	616	σ	58086	14.2326	46493
21-14.7379	69	69 196 364		54	23	12		0	0	7	7	0	0 12	93	4	8	∞	10	75434	14.2121	16832

k = 21, Designs sorted based on minimizing Lmax

Design	wlp (w4,)		wlp						alp				df	C2FI	C2FI Lmax	df	CZFI	Lmax	CD2*	CD2
		-	rank												-	rank	rank	rank		rank
21-14.2		400	2	1	51 1	12 1	1	0	0	0	0	0	123	28	4	24	10484	1	14.1761	<u>س</u>
21-14.3	184	152	3		48 1	00	0	0	0	0	0	0	120	24	4		25188	2	14.1753	Н
21-14.6	196	116	9			22	6	0	0	0	0	0	124	36	4	6	1156	m	14.1772	7
21-14.7	198	102	7		39 1	19 1	0	0	0	0	0	0	124	35	4	10	1882	4		œ
21-14.10	53 190 4	422	10	34		18 1	7	0	0	0	0	0	123	34	4	26	2365	Ŋ	14.1781	10
21-14.11	190	122	10		39 2	20 10	0	0	0	0	0	0	122	32	4	58	3933	9	14.1781	10
21-14.12		112	12		45 1	12 1.	3	0	0	0	0	0	123	32	4	27	3934	7	14.1783	12
21-14.18	196	104	17		39 1	1.8	7	0	0	0	0	0	123	34	4	29	2367	œ	14.1791	17

k = 21, Design generators

-14.	7	14	25	42	54	61	69	88	104		12	122	124	12	
1-1	7	30	35	38	41	52	81	82	104		12	122	124	-	
1-14.	7	29	30	35	37	41	44	70	73		11	121	122	12	
1-14.	7	11	19	29	35	42	69	73	81		10	119	120	<del>-  </del>	
ᅼ	7	11	19	29	35	38	52	73	101		H	121	122	12	
1-14.	7	11	30	35	49	92	84	88	104		11	121	122	Н	
21-14.7	7	11	13	19	21	22	25	35	61	62	78	84	111	120	
1 - 1	7	11	13	19	35	69	70	81	82		0	108	118	П	
1-1	7	11	19	25	26	59	92	97	86		11	121	122	12	
1-14:1	7	11	21	35	46	52	61	79	81		11	121	122	12	
1-1	7	11	19	29	35	45	53	57	70		7	94	108	Н	
1 - 14.1	7	19	25	28	31	38	22	62	84		11	121	122	12	
1-14.1	7	11	19	29	38	41	49	52	69		7	111	120	12	
1 - 14.1	7	11	19	29	35	45	53	22	63		7	81	119	-	
1 - 14.1	7	11	21	26	20	26	59	61	95		1	121	122	12	
$\vdash$	7	11	19	25	38	41	52	62	67		ω	92	109	12	
1-14.1	7	11	19	35	38	41	42	52	59		_	93	101	7	
1-14.1	7	22	35	38	41	20	55	26	101		11	121	122	12	
1 - 14.1	7	35	41	42	52	29	87	102	104		12	122	124	•	
1 - 14.2	7	11	19	28	31	35	49	16	82		1	121	122	12	
1-14.	7	11	35	38	42	49	20	16	101		Ξ	121	122	12	
1-14.11	7	11	21	35	46	52	69	73	97		Ξ	121	122	12	
-14.2	7	19	25	28	31	38	44	20	55		11	121	122	Н	
1-14.256	7	11	19	29	38	41	52	67	74		ω	109	118	12	
1-14.737	7	11	19	21	28	31	38	41	52	10		121	122	12	
1-14.1812	7	11	19	29	38	41	09	69	90	95	-	119	120	123	
-14.237	7	35	38	41	42	49	52	63	82	10		121	122	12	
-14.284	7		25	26	28	38	52	79	81	+-1	112	121	122	12	
-14.299	7	11	21	31	38	11	94	103	104	11	11	122		127	
-14.3873	7		25	26	31	41	53	91	104	11	115	121			
-14.415	7		13	19	21	31	47	20	16	<del>, -1</del>	112	121	122	124	
1-14 8068	7		ر 7	000		Ĺ	(	1	0	(	7	10			

k=22, Designs sorted based on word length pattern

2* CD2 rank	00	8019 2	8032 3	8043 4	8047 5	8047 6	8049 7	8058 8	8060 10	8060 10	060	-	1 190	070 2	8072 26	6 0908	8063 14	8065 16	8065 15	8066 17	8	
cD2	12.	•	12.	12.	12.	12.	5	12.	12.	12.	12.	12.	12.	12.	12.	12.	12.	12.	12.	12.	12.	
Lmax	94	94		94	. •	94	.,	7	.,	•		w	0,	30008	1(	Ξ	946	12	947	948	13	
C2FI rank	1458	3707	2998	187	3821	187	5514	99	54	17	64	9	99	11	9	5515	34660		3051	34661	S	
ax df rank	20	21	22	23	732	135	24	n	4	136	733	25	67	26	137	27	389	138		390	5	
C2FI Lmax	25 6	7	<del></del> 1	4		4	<b>ω</b>	6	2	0		6	_		7	<b>ω</b>	7	5	0	7	2	
df C2	24	24 ]	24 2	4	18	22 2	24 2	72	(;)	2	m	7	8	<#	2	1 2	1	0	4	120 1	5	
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	0						0															
	_						0 0															
alp	1																					
							5 5								9 /	7	0	Н	2	0	8	
	5 32	-	Н	7	٦	8	m	0	7	2	. 6 ]	m	٢			15	24	25	7	22	22	
	25 36	2	<b>□</b>	4	ц)	4	(*)	6	2 3	0 4	4 7	m	1 5	Φ	7 5	8 4	7 4	5 3	m	7 4	2 3	
wlp rank		2	ო	4	Ŋ	9	7	œ	6	6	11	12	13	14	15	16	17	18	19	20	21	
()	572	S	54	5	56	57	56	54	55	5	54	54	53	52	53	57	55	26	26	54	52	
wlp (w4,)	65 248	5 25	6 25	7 24	8 24	8 24	8 24	8 24	8 24	8 24	3 24	3 24	3 25	3 25	3 25	9 23	9 24	9 24	9 24	9 24	9 24	
Design	22-15.1	2-15.	2-15.	2-15.	2-15.	2-15.	2-15.	2-15.	7	2-15.1	2-15.1	-15.1	2-15.1	2-15.1	22-15.15	2-15.1	2-15.1	2-15.1	2-15.1	2-15.2	2-15.	

k=22, Designs sorted based on degrees of freedom used

CD2 rank	30	17429	∞	10	19	20	22	41	44	49
CD2*	8075	8406	12.8058	12.8060	12.8068	12.8070	12.8070	12.8081	12.8083	12.8085
Lmax rank	950	30303	4	S	13	949	14	24	27	928
C2FI rank	454	-1	3996	1549	1550	3052	1551	2409	1134	2411
df rank	г	7	m	4	5	9	7	ω	თ	10
	9	8	ഹ	2	S	9	2	2	5	9
C2FI Lmax	36	48	29	32	32	30	32	31	33	31
df C	127	127	125	125	125	125	125	125	125	125
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	Ö
	0	က	0	0	0	0	0	0	0	0
alp	0	0	0	0	0	0	0	0	0	0
	m	0	0	0	0	Н	0	0	0	<del>, -</del>
	Н	Н	Ţ	m	m	4	m	S.	2	Μ
	m	12	10	10	13	9	13	11	6	11
	36	24	22	28	22	27	22	19	25	21
	26	17	38	30	33	35	33	37	31	36
	36	48	29	32	32	30	32	31	33	31
wlp rank	26	4645	00	ത	21	22	23	39	43	46
	532		542	553	558	544	4	544	556	538
wlp (w4,)	248			48			244			43
wlp	69 2	Ŋ								
Design	22-15.26	15.4645	00.	0.0	15.21	5.22	5.23	39	43	.46

k=22, Designs sorted based on the number of clear two-factor interactions

CD2 rank	5 17429				35809
CD2*	12,8406	12,8381	12.8672	12.8648	12.8690
Lmax rank	30303	17314	37674	37728	37729
C2FI rank	1	7	m	4	rΩ
df rank	2	99	132	133	134
df C2FI Lmax	80	7	Q	6	თ
CZFI	48	48	48	48	48
df (	127	124	123	123	123
	0	0	Н	П	Н
	m	0	0	0	0
	0	Н	0	0	0
alp	0	5	14	14	14
, a	П	<del></del> 1	0	0	0
	12	20	0	m	c
	24	7	14		ω
	48 17	20	24	27	
	48	48	48	48	48
wlp rank	4645	89 210 546 8501	29288	30203	30206
<u></u>	192	546	216 501	514	492
W41	64	10	16	94	16
wlp(w4,)	85 2	89 2	104 2	105 1	105 2
Design	22-15.4645	22-15,8501	22-15.29288	22-15,30203	22-15.30206

k = 22, Designs sorted based on minimizing Lmax

Design	Wl	Wlp (W4,	1	wlp							alp	۵				df (	C2FI Lmax	Lmax	df	CZFI	Lmax	CD2*	CD2
				rank								1						н	ank	rank	rank		rank
22-15.3	1	254	544	6	21	52		-	2	0	0	0	0		0	124	21	5	22	29981		12.8032	3
22-15.5	89	240	568	S	<b>∞</b>	58		7	Ŋ	0	0	0	0	0	0	118	œ	Ŋ		38218	2	12.8047	2
22-15.7	89	241	568	7	28	34	30	ഹ	Ŋ	0	0	0	0		0	124	28	2	24	5514	e	12.8049	7
22-15.8	. 89	248	542	∞	29	38			4	0	0	0			0	125	29	2	n	3996	4	12.8058	<b>∞</b>
22-15.9		248	553	Q	32	30		10	က	0	0	0	0	0	0	125	32	2	4	1549	5	12.8060	10
22-15.10	89	248	553	σ	20	46		7	2	0	0	0	0	0	0	122	20	5	136	31744	9	12.8060	10
22-15.11	89	249	544	11	4	70		-	S	0	0	0	0	0	0	118	4	2		38644	7	12.8060	12
22-15.12	68	249	548	12	29	32	•	7	4	0	0	0	0	0	0	124	29	5	25	3997	<b>c</b> c	12,8061	13
22-15.13		253	536	13	21	20		12	4	0	0	0	0	0	0	123	21	5		29982	6	12.8067	18
22-15.15	68	256	530	15	17	54	16		9	0	0	0	0	0	0	122	17	5	137	34659	10	12.8072	26

1			-61	١												
7	١	1	0	20	27	11	r, r,	0	7.7	22	24	102	108	120	126	
.cT-2	_	<b>T</b> :	٦ .	23	2		0 0		, if	N 10	# ( ) (	707	7 C	7 7	1 6	
2-15.	7	11	19	30	38		52	19	74	8.1	93	0	111	114	120	
2-15.	7	11	19	30	38	41	59	61	74	82	92	98	111	118	120	
-15.	7	11	19	29	37	41	47	49	22	69	91	94	66	120	125	
-15.	7	11	19	41	52	62	73	82	84	94		101	$\Box$	113	120	
2-15.	7	11	19	38	41	20	09	63	69	91		106	11	118	120	
-15.	7	11	19	29	38	41	09	70	9/	82		109	11	118	120	
22-15.8	7	11	19	22	38	41	09	67	78	82	92	109	113	119	120	
2-15.	7	11	21	28	38	57	9/	83	90	95		111	118	120	123	
-15.1	7	11	19	29	37	41	47	59	77	78		91	10	119	120	
2-15.1	7	11	19	29	37	41	20	09	63	69		82	66	102	120	
2-15.1	7	11	19	29	30	38	41	49	09	78		95	10	119	120	
2-15.1	7	11	21	28	38	57	63	16	83	90		111	118	120	123	
2-15.1	7	11	19	29	35	45	52	52	29	73		98	108	114	120	
2-15.1	7	11	21	28	38	57	63	69	97	83		95	111	118	120	
22-15.16	7	11	19	38	27	09	70	73	92	84		66	110	118	120	
2 - 15.1	7	11	19	29	37	41	20	09	69	73		95	10	120	126	
2-15.1	7	11	19	38	41	52	59	73	9/	82		91	103	113	120	
-15.1	7	11	19	29	37	41	49	59	17			87	99	106	120	
-15.2	7	11	19	29	35	45	53	73	79	81		103	118	120	123	
22-15.21	7	11	19	29	38	41	20	52	73	82		106	108	118	120	
-15.2	7	11	13	19	22	38	22	9	73	82		66	106	118	120	
-15.2	7	11	19	29	38	41	20	55	73	82		66	108	118	120	
-15.2	7	11	19	29	38	41	55	62	29			108	114	120	123	
-15.3	7	11	19	29	35	45	53	59	10	73		87	103	120	126	
-15.4	7	11	19	29	37	41	49	52	29	70		8	σ	116	120	
-15.4	7	11	13	21	28	38	42	22	9/	83		97	111	118	120	
-15.46	7	11	19	29	30	35	41	42	44	47		59	7	118	120	
-15.85	7	11	19	29	38	41	47	10	73			109	110	117	120	
-15.2928	7		19	21	22	25	26	28	37			46	77	118		
2-15.3	7	11	19	21	22	25	26	28	31	32		67	77	118	120	
2-15 3020	7		0	21	C	L	0	C	,			-	יו	7		

k = 23, Designs sorted based on word length pattern

esign	WID (W4,)	( 1 4	wlp							alp	0			df	CZFI	Lmax	df	CZFI	Lmax	CD2*	CD2
			rank														rank	rank	rank		rank
16.1	3 31	74	1	12	52	24	6	7	2		0			125		7	10	32307	5495	11.5703	-
16.2	3 31	73	8	14	54	11	17	9	0					125	14	Ŋ	11	31330		11.5704	2
16.3	4 31	74	m	0	58	26	-1	11	0					119		5	472	34743	2	11.5713	m
16.4	84 319	726	4	12	54	16	10	σ	0	0	0	0	0 0	124	12	5	51	32308	m	.57	9
16.5	5 30	74	5	6	49	20	16	7	2					121		9	249	33463	61	11.5716	4
16.6	5 30	7.5	9	25	26	34	12	4	Н					125		9	12	9682	62	11.5721	5
16.7	5 31	73	7	22	38	26	9	7	-					126		9	Н	22091	63	11.5727	80
16.8	5 31	71	<b>ω</b>	17	44	26	œ	4	m			0		125		9	13	29653	64	1.57	15
16.9	6 29	76	σ	20	32	29	14	4	Ч					123		9	95	26421	65	11.5727	7
16.10	6 30	75	10	18	37	27		œ	0					123		5	96	28456	4	11.5734	13
16.11	6 30	74	11	4	53	23		10	0		_			119		5	473	34497	5	11.5734	10
16.12	9 30	74	12	9	46	31	4	ω	Н		0			119		9	474	34227	99	11.5734	10
16.13	6 30	74	13	0	64	13	10	œ	-					119	0	9		34744	67	11.5734	10
16.14	5 30	73	14	10	48	21	12	9	٦					121	10	9	250	32981	89	11.5735	14
16.15	G	72	15	23	35	30	ω	4	٣					126	23	9	2	18285	69	11.5737	16
16.16	ıo	69	16	7	99	16	9	7	4					125	7	∞		34110	20195	11.5753	26
16.17	G	69	17	13	45	36	0	0	7	_	0			124	13	9	52	32028		11.5760	31
16.18	7	79	18		42		21	9	0	0				125	22	വ		22092	9	11.5732	6

k=23, Designs sorted based on degrees of freedom used

CD2 rank		7 16			5 39		0 155			3
CD2*	11.5727	11.5737	•	•	11.5765	•	•	11.5823	11,5863	11.5703
Lmax rank	63	69	73	16	5497	91	145	20200	338	5495
C2FI rank	22091	18285	6412	2668	13130	6415	1289	4520	208	32307
k df rank	<b>,</b> →	2	m	4	5	9	7	00	Q	10
C2FI Lmax	9	9	9	9	7	9	9	ω	9	7
CZFI					24			27		12
df	126	126	126	126	126	126	126	126	126	125
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
alp	0	0	0	0	0	0	0	1	0	0
10		0	0	0		0	0		0	П
		4 3		0	7	7 2	0	4	3 4	2
	6	8	ω				25 (		25	0
		30		1 21	21 1	2		1		4
	38 2						33 1	31 2	27	52 2
	22 3			28		26		27	36	12 5
wlp rank	7	15	21	29	31	47	123	124	537	Н
<u> </u>	730	728	754	745	724	728	725	717	776	744
wlp (w4,)	312		300				292			316
Wl	85					68	92	92		83
Design	23-16.7	23-16.15	23-16.21	23-16.29	23-16.31	23-16.47	23-16.123	23-16.124	23-16.537	23-16.1

k=23, Designs sorted based on the number of clear two-factor interactions

Design	wlp(w4,)	wlp rank					ď	alp				df C	2FI	df C2FI Lmax ra	df rank	C2F. ran	df C2FI Lmax rank rank	CD2*	CD2 rank
23-16,9896	115 244 740 9896	9686 0	45	6 27	27	4	5	0	m	0	0	0 123	45	ω	189	-	23298	6118	18586
23-16.32406	140 140 1109	09 32406	44	18	0	. ·	12 1	7 1	0	0	0	116	44	7	3056	7	19930	11.6418	32819
23-16,32595	141 138 1102	02 32595	44	18	0	2	12 1	4 3	0	0	0	116	44	7	3057	m	19948	11.6430	32929
23-16,32597	141 138 1104 32597	04 32597	44	18	0	0	17 1	1 2	1	0	0	116	44	œ	3058	4	29387	11.6431	32933
23-16,32747		95 32747	44	18	0	5	6 1	7 3	0	0	0	116	44	7	3059	വ	19968	11.6446	33033
23-16,32751		95 32751	44	18	0	ω	12 1	٦ 5	0	0	0	116	44	7	3060	9	19972	11.6446	33036

k = 23, Designs sorted based on minimizing Lmax

CD2 rank	2	m	9	13	10	<u>ه</u>	24	18
CD2*	11.5704	11.5713	11.5722	11.5734	11.5734	11.5732	11.5750	11.5742
Lmax		2	က	4	Ŋ	9	7	œ
C2FI	31330	34743	32308	28456	34497	22092	22093	13127
df rank	11	472	51	96	473	15	17	97
C2FI Lmax	S	S	S	വ	Ŋ	Ŋ	S	2
CZFI	14	0	12	18	4	22	22	24
df	125	119	124	123	119	125	125	123
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
alp	0	0	0	0	0	0	0	0
a	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	9	11	σ	ω	10	9	9	5
	17	Н	10	10	9	21	21	19
	11	26	16	27	23	11	11	24
			54			42	42	28
	14	0	12	18	4	22	22	24
wlp rank	2	٣	4	10	11	18	22	24
	734	744	726	753	740	790	750	820
( W4	318		319					284
wlp (w4,)			84 3				87 3	88 2
Design	23-16.2		23-16.4				23-16.22	

k = 23, Design generators
Design Design

Design Generators

		0	0	0	m	w	0	0	ω.	0	0	0	0	0	0	0	0	0	0	0	0	m	0	0	0	0	0	0	0	0	0	7.	
	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	72	17	12	12	12	7	H	7	12	12
	1-1	118	$\vdash$	$\vdash$	$^{\circ}$	$^{\circ}$	-	⊣	$^{\circ}$	$\overline{}$	0	4	$\neg$	$\vdash$	$\circ$	$\circ$	$\overline{}$	118	$\overline{}$	$\overline{}$		(1	4	$\overline{}$	_	_	$\circ$	$\sim$	$\sim$	$\sim$	·	124	$\sim$ $_{\rm I}$
	0	110	7	$\vdash$		0	90	$\circ$	119	$\circ$	$\circ$	66	$\circ$	$\overline{}$	$\circ$	$\circ$	102	_	$\circ$	0,	1	$\overline{}$	$\sim$	109	$\sim$	$\sim$	94	82	93	93	78	122	93
		_			_	٠,	89	_	_	~	•	91	~	_	~	_		σ.	$\overline{}$	92	26	111	66	66	94	98	82	73	62	22	62	121	55
	92 1	93	06 1	ഗ	$\circ$	84 ]	87	73	99	91	82	87	93	. 60	90	92	87	93	83	82	93	101	91	82	82	73	9/	29	61	20	61	117	20
	81	84	99 1	٥,	82 1	82	9/	69	92	84	73	82	87	99 1	89	98	73	84	87	11	97	10	82	79	97	29	74	53	22	44	47	110	47
	17	97	94	11	9/	74	10	63	82	78	69	78	73	82	84	78	63	81	70	62	69	06	79	97	74	54	73	41	20	41	44	104 1	44
	16	73	37	52	73	69	59	90	73	17	63	17	63	29	20	29	09	9 /	29	55	59	83	9/	73	73	53	29	35	44	38	41	86 1	41
		_	m	<u></u>	7	10	10	0	m	o.	0	ത	0	Ŋ	7	m	0	m	2	6	0	9	3	σ	<sub>C</sub>	2	S	Н	<del></del> 1	S)	2	54	00
		_	01	σ.	m	7	6	_	7	7	0	10	7	7	_	2	-	0	6	_	4	7	σ	0	<del></del> 1	N	$\vdash$	9	ω	9	ω	28	2
	_		0		9		Н		ω			-	ω		ω	5	7	0	Н	$\vdash$	$\vdash$	0	1	П	7	ω	7	2	$\leftarrow$	S	9	25	2
1				41,	35	37	37	37	28	37	37	37		7	_	10	35	57	37	37	38	38	37	37	35	26	35	19	19	21	25	19	21
	l.,		~	•	~	σ.	~	~	10	•	σ.	0	Δı	0	on.	10	ത	m	ത	ത	0	ထ	σ	0	ത	വ	0	4	4	0	6	14	0
	5		0	6	6	თ	0	6	-	0	6	6	9						S	6	9	$\vec{\vdash}$	6	9	σ	9	6	$^{\circ}$	ന	$^{\circ}$	က	13	m
	1		Н	Н	Н	Н	-	-	$\vdash$	Н	⊣	-1	Н	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
	1	7														7	7		7	7	7											7	- 1
																													0	9	9	47	വ
	-	2	က	Ţ.	2	9	7	ω	0	10	11	12	13	14	15	16	17	18	21	22	24	29	31	47	$^{\circ}$	$\sim$	3	$\infty$	$^{\circ}$	$\sim$	$^{\circ}$	327	327
1	-	3-16.	4	ᅻ	근	7	ᅻ	ij	ᅼ	딕	ᅼ	Ţ	근	7	7	77	7	딕	T	-1	-1	T	7	7	T	딘	7	7	7	7	7	3-16.	7
)	23	23	23	23	23	23	23	23	23	23	2	23	2	2	2	2	2	2	2	2	2	2	2	7	2	2	2	Ŋ	2	7	7	7	7

k = 24, Designs sorted based on word length pattern

CD2	rank		2	က	7	4	5	9	11	15	8	10	14	6	12	13	18	16	22	19	19
CD2*		10.4617	10.4631	.46	10.4655	464	10.4649	10.4653	10.4679	10.4687	10.4663	10.4671	10.4686	10.4668	10.4682	10.4686	10.4693	10.4692		10.4696	10.4696
Lmax	rank	4	1	S	9	7	<b>0</b> 0	6	10050	1118	10	11		2	12		e	14	15	16	1120
CZFI	rank	27865	26967		24068	24069	27675	27306	7	26390	27866	619	25053	22970	27867	586	22971	24822	22403	1	27676
df	rank	120	7	٦	2	54	4	121	∞	0	4	122		11	250	123	12			253	
Lmax		9	2	9	9	9	9	9	œ	7	9	9	7	5	9	9	5	9	9	9	7
C2FI		0	7	14	15	15	က	Z,	4	ω	0	6	12	16	0	10	16	13	17	4	m
df			126	127	127	124				$^{\prime\prime}$	120	2	126	126	120	122	126		124	120	120
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	Н	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	7	4	0	0	m	0	0	0	0	0	0	0	<del></del> 1
alp		4	0	m	7	2	7	7	4	n	4	7	0	0	m	Н	0	٣	ო	4	m
		0	12	9	0	7	11	9	0	0	7	10	m	12	10	14		ω	σ	∞	7
		24	17	7	12	15	m	13	9	m	6	12	24	26	12	ω	26	14	13	11	11
ĺ		16	σ	31	33	32	40	24	32	42		27	12	0	18	28	0			26	
		54	57	39	36	29	37	45	53	42	47	38	48	48	53	37	48	31	30	43	44
		0	7	14	15		m	S	4	ω	0	თ	12	16	0	10	16	13	17	4	က
wlp	rank	7	7	m	4	2	9	7	ω	0	10	11	12	13	14	15	16	17	18	19	19
		992	985	972	960	1026	1008	988	$\sim$	2	1000	994	886	1072	966	987	1012	1000		988	$\infty$
1		384	394	393	392	372	374	378	00	0.2	174	10	80	25	29	10	73	63	99	29	67
wlp (w4,)		7	2	m							9.						8	g G	9	დ დ	
Wlr		H	10	10	10	105	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Design		-17.	4-17.	4-1	4-17.	4-17.	24-17.6	4-17.	4-17.	4-17.9	4-17.1	-17.	4-17.1	4-17.1	4-17.1	4-17.1	4-17.1	4-1	4-17.1	4-17.1	24-17.20

k=24, Designs sorted based on degrees of freedom used

CD2 rank	m	7	25	45	133	178	7	11	15	14
CD2*	10.4643	10.4655	10.4703	10.4723	10.4768	10.4779	10.4631	10.4679	10.4687	10.4686
Lmax rank	5	9	1122	1126	1157	20625	<b>~</b>	10050	1118	1119
C2FI rank	24313	24068	19896	9940	9941	9943	26967	27392	26390	25053
df rank	-1	7	ო	4	Ŋ	9	7	ω	6	10
C2FI Lmax	9	9	7	7	7	თ	Ŋ	ω	7	7
SZFI	14	15	20	24	24	24	7	4	ω	12
df (	127	127	127	127	127	127	126	126	126	126
	0	0	0		0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	Н	0	0	0	0
alp	0	0	0	0	0	0	0	$\vdash$	0	0
ď	0	0	Н	m	m	Н	0	2	4	က
	m	7	m	0	Н	4	0	4	m	0
	0	0	ω	m	m	4	12	0	0	m
	1	12	12	27	33	11	17	9	m	24
	31	33	25	16	0	32	σ	32	42	12
	39	36	34	30	39	26	57	53	42	48
	14	15	20	24	24	24	7	4	ω	12
wlp rank	m	4	22	35	91	94	7	∞	6	12
	972	960	896	966	972	964	985	930	928	988
W4 r	393					364				
wlp(	1	104	109	111	115	115	102		105	107
	m	4								
Design wlp(w4,)	24-17.3	24-17	24-17.	24-17.	24-17.	24-17.94	24-17.2	24-17.8	24-17	24-17.12

k=24, Designs sorted based on the number of clear two-factor interactions

Design	wlp	wlp(w4,)	wlp			ď	alp						df C	C2FI Lmax df rank	Lmax		C2FI rank	Lmax rank	CD2*	CD2 rank
24-17.28100	250 54	250 54 2304	28100	45	0	0	0	0	1 15	15	0	0	100	45	8	28068	Н	20624	10.6570	28100
24-17.28101a 251 53 2296	251 53	3 2296		45	0	0	0	0	1 17	12	0	-	100	45	10	28069	7	27802		28101
24-17.28101b 251 53 2296	251 53	3 2296		45	0	0	0	0	2 15	12	7	0	100	45	σ	28069	7	26133	10.6583	28101
24-17.28101c 251 53 2296	251 53	3 2296		45	0	0	0	0	2 15	12	~	0	100	45	0	28069	7	26133	10.6583	28101
24-17.28104	251 54	251 54 2296		45	0	0	0	0	2 15	12	7	0	100	45	6	28072	വ	26135	10.6584	28104
24-17.28105	251 55	5 2296		45	0	0	0	0	2 15	12	~	0	100	45	თ	28073	9	26136		28105
24-17.28106	251 56	6 2296		45	0	0	0	0	1 17	12	0	Ц	100	45	10	28074	7	27803		28106
24-17.28107	252 52	2 2288		45	0	0	0	0	4 12	12	m	0	100	45	6	28075	ω	26137	10.6595	28107

k = 24, Designs sorted based on minimizing Lmax

															- 1				
Design	) dTM	WID (W4,)	wlp					๗	alp			df	CZFI	C2FI Lmax	df	CZFI	Lmax	CD2*	CD2
			rank												rank	rank	rank		rank
24-17.2			2	7	57	9 1	17 12	2	0	0	0	126	7	5	7	26967	-	10.4631	2
24-17.13	108 352	1072	13	16	48	0	26 12	2	0	0	0	126	16	2	11	22970	2	10.4668	σ
24-17.16			16	16	48	0	26 12	2	0	0	0	126	16	Ŋ	12	22971	m	10.4693	18
24-17.1			-	0		162	24 (	0	0	0		122	0	9	120	27865	4	10.4617	-
24-17.3			m	14	39 3	31	7	9	0	0		127	14	9		24313	2	10.4643	m
24-17.4			4	15 3(	0	33 1	12 (	C ',	0	0	0	127	15	9	2	24068	9	10.4655	7
24-17.5			5	15	6	32 1	15	7 2	0	0	0	124	15	9	54	24069	7	10.4648	4
24-17.6			9	m	7	40	3 11	1 2	0	0		120	m	9	248	27675	œ	10.4649	വ
24-17.7			7	2	10	4	13	9	0	0	0	122	S	9	121	27306	0	10.4653	9
24-17.10			10	0	47 2	თ	9	7 4	0	0	0	120	0	9	249	27866	10	10.4663	00

Design						De	S1.	gn G	Gener	ator	Ø							
1-17.	1	11		2	3	4	S	5	7	97	82	87	100	-		$\sim$	12	
1-17.	7	1	Н	$\mathcal{C}$	S	5	9	7	7	16	81	84	93		-	$\leftarrow$	12	
1-17.	7	11	Н	0	4	4	4	2	9	77	82	92	97	$\vdash$	$\overline{}$	-	12	
1-17.	7	11	Н	0	C	$^{\circ}$	4	S	9	63	69	73	82		0	$\leftarrow$	12	
1-17.	7	11	0	0	0	$^{\circ}$	വ	9	7	16	82	95	66	П	-1	$\sim$	12	
1-17.	7	디	Н	2	m	വ	വ	7	_	82	94	98	0	$\leftarrow$	$\overline{}$	$^{\circ}$	12	
1-17.	7	11	Н	N	ന	4	വ	വ	7	16	82	94	100	$\vdash$	118	120	12	
1-17.	7	11	7	2	0	സ	4	വ	9	67	78	86	92	$\vdash$	0	0	12	
1-17.	_	H	Н	7	m	സ	4	Ŋ	9	63	73	87	94	4	$\vdash$	$\leftarrow$	12	
1-17.1	7	11	Н	2	ന	4	വ	Ø	7	82	87	66	106	$\Box$		11	12	
1-17.1	7	11	۲	N	സ	4	작	ഗ	9	69	97	89	90		$\vdash$	12	12	
1-17.1	7	11	-	m	ന	4	4	4	വ	61	74	87	93	$\overline{}$	$\leftarrow$	11	12	
1-17.1	7	11	٦	m	Ŋ	9		-	1	81	84	91	93		$\leftarrow$	11	12	
1-17.1	7	11	-	N	ന	4	ш)	O	w	79	87	89	100	4	$\vdash$	12	12	
4-17.1	7	11		N	m	4	4	ц)	ഗ	62	82	99	109		₩	11	12	
4-17.1	7	11	Н	N	(T)	4	4	4	L)	59	62	17	78		84	O1	12	
4-17.1	7	11	Н	N	(7)	4	7	ц,	ц)	62	77	78	91		98	11	12	
4-17.1	7	11	М	N	(1)	4	4	Ā	L)	62	69	84	89		OJ.	10	12	
4-17.1	7	11	Н	N	(1)	4	4	w	_	16	87	66	$\circ$	-	117	7	12	
4-17.2	7	11	-	N	(1)	4	ц,	ц,	1	16	82	94	100	_	4-4	12	12	
4-17.2	7	11	Н	N	(*)	(*)	7	ц,	w	63	69	73	16		O)	Η	12	
4-17.3	7	11	N	N	(*)	4	ц,	1-	ω	90	92	101	105	-	-	12	12	
4-17.9	7	11	П	N	(')	(,)	7	ш,	U,	73	74	16	82		102	H	12	
4-17.9	7	11	П	CA	(1	(,)	7	u,	ц,	59	69	70	82	* 1	П	Π	7	
4-17.2810	1	19	C/I	N	(,)	(,)	۲٠,	7	w	69	81	87	92	٠.	$\circ$	Ξ	Ξ	
4-17.28101	7	19	(1	(A	(,)	(')	(,)	7	u,	67	81	84	95	٠.	$\circ$	Η	Ξ	
24-17.28101b	7	19	21	(A	2 3	35 37	7 38	49	50	67	70	81	84	95	97	100	112	
4-17.28101	7	13	(1	(A	۲٠,	٠.,	( )	7	w	69	81	82	87		$\neg$	H	$\Box$	
4-17.2810	7	19	(1	(1	(.,	(,,	.,	7.	Δ,	67	69	81	84		100	H	Η	
4-17.2810	7	19	(1	(1	(,,	.,	.,	7	w	81	87	92	100	٠.	_	$\Box$	$\Box$	
4-17.2810	7	13	CA	(1	(,)	۲٠,	.,	7	•	81	82	87	92	٠.	$\circ$	÷	Ξ	
4-17.2810	7	19	(1	(1	٧٠,	۲٠,	٠.,	7	~	67	81	82	84		97	H	1	
	ŀ		l															

k = 25, Designs sorted based on word length pattern

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Design	Mlb (	W1D (W4,)	wlb				alp	۵				df		C2FI Lmax	df C2FI	Lmax	CD2*	CD2
			rank												rank rank	rank		rank
25-18.1	124 482	1312	1	0 64	0	18 20	0	0	0	0	0	12.	7 0	2	1 20240	1 5	9.4697	1
25-18.2	125 504	_	2	0 41	48	0 9	0	9	Н	0	0	12		ω	2 20241	3424 9	9.4730	က
5-18.	ω	12	27	12 48	0	27 12	0	0	m	0	0	12	7 12	ω	3 17806	3427 9	9.4839	44
5-18.	142 416	1	51	20 30	20	10 16	4	0	7	0	0	12		∞	4 14176	3437	9.4854	99
5-18.	143 419	1312	63	25 16	36	0 20	0	Ŋ	0	0	0	12	7 25	7	5 4870	130	9.4868	104
5-18		13	134	25 22	22	14 9	ω	0	7	0	0	12			6 4871	3481	9.4896	239
5-1			136	12 53	0	17 12	9	0	$\vdash$	0	Н	127	7 12	10	7 17814	17107 9	9.4929	570
-18.	147 423	1280	193	20 32	22	0 25	0	Н	0	7	0	12			8 14184	11141	9.4925	521
5-18.			874	28 22	16	16 12	Ŋ	0	7	0	$\vdash$	12	7 28		986 6	17188	9.4990	1767
25-18,988	155 367	1440	988	36 0	42	0 15	0	თ	0	0	0	12			10 44	176	9.4973	1366
5-18.	5 3		1021	36 0	39	0 24	0	0	0	က	0	12		თ	11 45	11472	9.5000	2053
5-18.	155 415		1022	23 32	18	0 24	0	4	0	0	0	1 127	7 23		12 13544	19796	9.5017	2559
5-18.	163 359		2757	39 0	36	0 21	0	m	0	က	0	0 12	7		13 43	12242	9.5066	4973
5-18.	143 404	1386	59	20 31	10	25 4	10	0	Н	0	0	0 12	6 20	80	14 14178	3440	9.4855	71
25-18.137	146 456	1184	137	0 72	0	0 24	4	0	0	0	0	0 1 12	9	12	15 20267	20477	9.4946	962

k=25, Designs sorted based on the number of clear two-factor interactions

Design	wlp(w4,)	W4r	î	wlp rank					alp					df O	CZFI	Lmax	df rank	C2FI rank	Lmax rank	CD2*	CD2 rank
25-18.20549a	304 61 3105	1.3	1105	20549	47	0	0	0	0		3 21	9	1	103	47	10	20527	-	19773	9.6836	20549
25-18.20549b		1 3	3105	20549	47	0	0	0	0	7	1 18	9	0	103	47	0	20527	Н	17104	9.6836	20549
25-18.20551	304	62 3	3105	20551	47	0	0	0	0	7	18	σ	0	103	47	σ	20529	ო	17105	9.6837	20551
25-18,20552		63 3	1105	20552	47	0	0	0	0	0	3 21	9	Н	103	47	10	20530	Ţ	19774	9.6839	20552
25-18,20553	305 60		9601	20553	47	0	0	0	0	, (	6 15	Q	Н	103	47	10	20531	Ŋ	19775	9.6847	20553
25-18.20554	305 6	6	3096	20554	47	0	0	0	0	~ C	5 15	σ	Н	103	47	10	20532	9	19776	9.6848	20554
25-18,20555	305 6	(f)	9608	20555	47	0	0	0	0	<u> </u>	5 15	თ	Н	103	47	10	20533	7	19777	9.6848	20555
25-18.20556		62 3	3096	20556	47	0	0	0	0	Ċ	5 15	σ		103	47	10	20534	ω	19778	9.6850	20556
25-18,20557	306 6	60 3	3089	20557	47	0	0	0	0	~	8 12	6	7	103	47	10	20535	6	19779	9.6860	20557

k = 25, Designs sorted based on minimizing Lmax

	CD2 rank	1	2	4	9	12	13	14	14	14	20
	CD2*	9.4697	9.4704	9.4732	9.4747	9.4777	9.4781	9.4782	9.4782	9.4782	9.4794
	Lmax rank		7	က	4	2	9	7	7	7	10
	CZFI Lmax rank rank	20240	20242	19619	18698	20247	17805	20248	19943	20248	16698
-	dt rank	7	45	46	47	48	95	116	117	901	20
	rmax	5	9	9	9	9	9				9
	CZFI Lmax	0	0	5	g	0	12	0	e	0	15
- 1	A H	127	123	123	123	123	122	121	121	118	125
		0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0
١		0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0
	alp	0	0	0	0	0	0	0	0	0	0
	roi	0	4	4	9	4	9	10	10	10	σ
		20	12	15	10	24	15	9	9	т	12
		ı	12	7	12	0	m	15	12	15	က
		0	28	34	35	16	43	20	29	35	37
		64	42	33	26		18	45	36	30	24
		0	0	വ	σ	0	12	0	က	0	15
	wip	г	m	4	9	12	13	14	14	14	19
-	···	1312	1304	1310	1324	1280	1348	1320	1320	1320	1338
1	wlp ( w4,	482	468	458	448	444	432	435	435	435	432
-	MT.	124 4	126 4	129 4	131 4	134 4	135 4	135 4	135 4	135 4	136 4
	Design	25-18.1	25-18.3	25-18.4	25-18.6	25-18.12	25-18.13	25-18.15b	25-18.14	25-18.15a	25-18.19

k = 25, Design generators

	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	H	17	1	12	7	7	7	1	H	H	$\exists$	H	H	H	H	H	115	H	H
	102	114	120	119	116	120	116	118	118	118	116	120	119	120	120	120	118	118	118	120	120	120	122	120	111	124	120	124	118	124	120	109	120	112	112	112	112	115	112	112	117	112
		4		$\overline{}$	-		•	ς,			٠.			٠,	٠.	, ,	٠.																							111		
	84	103	109	98	101	111	102	111	111	111	101	109	97	109	109	106	111	111	106	95	117	97	118	109	93	121	117	121	81	121	97	97	103	100	97	100	100	111	97	98	103	97
	82	100	100	97	66	98	66	106	106	106	66	100	93	100	100	100	106	106	100	92	110	85	112	94	87	115	78	115	79	112	81	92	95	95	87	97	92	97	87	97	100	87
	78	92	87	93	91	97	91	87	66	66	91	87	84	98	97	83	66	66	91	82	109	16	107	87	82	112	11	112	74	104	79	82	92	84	81	87	87	87	81	87	92	82
	77	86	82	84	87	91	87	82	94	87	87	82	82	94	94	87	87	91	87	73	66	74	104	81	81	104	67	104	73	101	74	73	82	81	70	81	82	82	70	81	87	81
Ø	62	78	16	82	73	78	82	73	87	82	73	16	79	82	82	79	82	87	82	69	92	73	95	79	69	102	46	102	70	87	73	9	9	69	69	70	81	81	69	70	82	70
rator	59	67	73	79	70	77	78	62	82	73	70	73	73	76	97	69	16	82	78	55	89	9	78	73	28	86	45	86	69	82	70	53	41	67	67	69	67	69	67	69	81	69
Gener																																								67		
gn G	1		57	_					٠.		55	57	57	69	70						9 '	41																		8 49		
si	4	4	53	5	4	4	S	ນ	S	5	41	53	52	57	57	4	വ	9	141	4	3 57	26	2 44	Ŋ		S	7	5	S	4	S	7	7	m	സ	m	က	ന	ന	က	က	സ
De	7	1.,	•	-	.,	7	~	•	•	-	٠,	-	-		-,	٠.,																								35 37		
	3	0	35	r	7	က	C	က	$^{\circ}$	m	m	ന	m	m	m	N	m	(7)	(*)	(*)	(*)	П	(1	(*)	_	(,)	(4	(')	(,)	4.	٠,	_	_	۲٠,	(-)	.,	٠.,	.,	.,	.,	٠.,	.,
	2	~	0	സ	Н	N	~	N	0	0	Н	N	m	N	~	М	(1	CA.	(1	(1	(1	-	"	(1	_	١٠,	.,	(.,	. 4	٠,	.,	3 1/	3 17	1 23	2	1 23	22	•	•	1 22	•	
	19	19	19	19	13	13	19	Н	Н	-	+	Н	Н	٦	4	Н	Н	7	-	_	1,5	1	2	5	1	1	5		_	(*)	-	H	1	-				~	7	0	7	7
	11	11	Ξ	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	27	11	Н	Н	~~	Н	Н	Н	Н	~	119	Н	-
	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	1	7	_	_	_	_	1	-	-	-	-	-1	٠.		1-	[-	1-	1-	7	1-	
-	۲.	2	m	4	.5	9.				Н	↽		.13	.14	.15a	.15b	.17	۳.	Н	2	4	ı,	.59	9	.13	.13	.13	.19	.87	.98	.102	.10	.275	.2054	.20549	.2055	.2055	.2055	.2055	.20555	.2055	.2055
Design	-18	1-18	1-18	5-18	5-18	5-18	5-18	5-18	5-18	5-18	5-18	5-18	1.5	5-1	5-1	Ľ	17	1-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	S	5-1	7

c = 26, Designs sorted based on word length pattern

0         29         41         4         16         8         0         0         0         124         6         13         13068         1         8.5797           5         20         4         5         13         10         0         0         124         5         6         13         13068         1         8.5819           0         30         20         6         5         5         0         0         0         0         124         5         6         13069         8         8.5819           15         18         27         19         15         6         3         1         0         0         0         122         0         4         41         13070         708         8.5865           15         18         27         19         15         6         0         0         0         122         0         4         4         13070         708         8.5865           15         18         27         19         5         6         0         0         0         122         0         4         4         13072         709         8.5890	0 0	wlp(w <sub>4</sub> ,) wlp	wlp	WOLG L	engr	_1	pattern		alp					df	df C2FI Lmax	Lmax		CZFI	Lmax	CD2*	CD2
29 41 4 16 8 0 0 0 0 0 0 124 0 6 13 13068         1           20 45 5 13 10 0 0 0 0 0 0 124 5 6 14 12525         2           30 30 20 6 5 5 0 0 0 0 0 0 122 0 7 43 13069         8           31 3 23 25 5 6 3 1 0 0 0 0 0 122 0 8 44 13070         708 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	rank	rank															rank	rank	rank		rank
20         45         5         13         10         0         0         0         124         5         6         14         12525         2         6         13         30         8         8         8         13         30         8         8         8         8         13069         8         8         8         8         13069         8         8         13069         8         8         13069         8         8         13069         8         8         13069         8         8         13069         8         8         14100         0		Н			41	4 1(	90	0	0	0	0	0	0 0	124	0	9	13	13068	1		-1
30         30         20         6         5         5         0         0         0         122         0         7         43         13069         8           33         23         25         5         6         3         1         0         0         0         122         0         8         44         13070         708         8           36         19         25         6         4         0         0         0         0         122         0         44         13070         708         8           36         19         25         6         4         6         0         0         0         0         7         45         13071         10         8           31         29         14         10         6         0         0         0         0         122         0         7         46         12806         11         9           42         28         0         12         0         0         0         0         122         0         12         44         13072         10         13         12         12         0         0         0	555 1720 2	7				5 1	3 10	0	0	0	0	0	0	124	S	9	14	12525	2	8.5819	2
33         23         25         5         6         3         1         0         0         0         122         0         8         44         13070         708         8           18         27         19         15         0         0         0         0         126         15         7         45         13070         9         8           36         19         25         6         4         6         0         0         0         0         7         45         13071         10         8           30         19         31         3         4         6         0         0         0         0         122         0         7         45         12806         11         0         8         49         13072         10         8         44         13072         709         8         48         13072         709         8         48         13072         709         8         48         13074         13         8         13074         13         8         13074         13         8         12         9         10         0         0         0         0         0	530 1767 3	m		0 30		20 (	5	Ŋ	0	0	0	0	0	122	0	7	43	13069	80	8.5854	e
18     27     19     15     0     6     0     0     0     0     126     15     7     3     10630     9     8       36     19     25     6     4     6     0     0     0     0     122     0     7     45     13071     10     8       33     14     10     6     2     2     0     0     0     0     122     0     7     45     13072     10     8       42     28     0     1     0     0     0     0     0     122     0     4     13072     10     8       39     17     21     9     3     7     0     0     0     0     122     0     7     48     13072     10     8       42     8     0     1     0     0     0     0     0     122     0     4     8     13074     13     8       3     1     2     0 </td <td>530 1758 4</td> <td>4</td> <td></td> <td></td> <td></td> <td>25</td> <td>9</td> <td>m</td> <td>٦</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>122</td> <td>0</td> <td>œ</td> <td>44</td> <td>13070</td> <td>708</td> <td>8.5865</td> <td>4</td>	530 1758 4	4				25	9	m	٦	0	0	0	0	122	0	œ	44	13070	708	8.5865	4
36 19 25     6 4 6 0 0 0 0 0 0 122     3 7 46 13071     10       30 19 31     3 4 6 0 0 0 0 0 122     3 7 46 12806     11     6       32 29 14 10 6 2 2 0 0 0 0 122     3 7 46 12806     11     6       42 28 0 12 15 1 0 0 0 0 0 122     0 7 48 13072     709       39 17 21 9 3 7 0 0 0 0 0 122     0 7 48 13074     13     8       42 8 30 6 6 1 3 0 0 0 0 122     0 122 0 8     49 13074     13     8       33 32 2 9 14 3 0 0 0 0 0 124 5     16 12526     14 8     8       22 24 29 1 5 6 1 0 0 0 0 0 122     8 8 50 11866     712 8       33 24 14 12 2 8 0 0 0 0 0 0 122     3 7 51 12807     16 8       21 30 13 6 8 0 0 0 0 0 0 122     3 7 51 12807     16 8       42 16 15 13 4 4 2 0 0 0 0 0 0 122     8 52 13076     713 8		S				19 15	2	9	0	0	0	0	0	126	15	7	က	10630	6	8.5879	ເກ
30 19 31     3 4 6 0 0 0 0 0 0 122     3 7 46 12806     11       33 29 14 10 6 2 2 0 0 0 0 122     0 122 0 8 47 13072     709 8       42 28 0 12 15 1 0 0 0 0 0 124 0 7 15 13073     12 8 13074     13 8       39 17 21 9 3 7 0 0 0 0 0 122 0 8 49 13075     710 8       42 8 30 6 6 1 3 0 0 0 0 122 0 8 49 13075     710 8       32 3 2 2 9 1 4 3 0 0 0 0 0 124 8 7 16 12526     14 8959       33 32 2 9 1 5 6 1 0 0 0 0 124 8 7 16 12526     14 8959       33 32 4 14 12 2 8 0 0 0 0 0 122 3 7 112807     8 8 50 11866       21 30 13 6 9 6 0 0 0 0 0 122 3 7 51081     16 8 52 13076       42 16 15 13 4 4 2 0 0 0 0 0 122 0 8 52 13076     713 88		9				25	10 4	9	0	0	0	0	0	122	0	7	45	13071	10	8.5880	9
33     29     14     10     6     2     2     0     0     0     0     122     0     8     47     13072     709     8       42     28     0     12     15     10     0     0     0     0     124     0     7     15     13073     12     8       42     8     30     12     0     0     0     0     0     122     0     8     49     13074     13     8       3     17     13     0     0     0     0     0     122     0     8     49     13075     710     8       3     2     3     0     0     0     0     0     126     24     8     49     13075     710     8       3     2     2     9     4     3     0     0     0     0     0     0     0     122     8     4     4959     711     8       2     2     4     4     3     0     0     0     0     0     122     8     7     14     8       3     3     2     4     4     1     0     0     0	523 1752 7	7				31	3 4	9	0	0	0	0	0	122	٣	7	46	12806	11		9
42     28     0     12     15     13     12     8       39     17     21     9     3     7     0     0     0     0     0     122     0     7     48     13074     13     8       42     8     30     6     6     1     3     0     0     0     0     122     0     8     49     13074     13     8       3     2     8     3     0     0     0     0     0     126     24     8     4     8959     711     8       22     24     29     1     3     0     0     0     0     0     124     5     7     16     12526     14     8       22     2     4     3     0     0     0     0     0     0     0     122     8     50     11866     712     8       22     24     2     4     4     2     0     0     0     0     0     122     3     7     51     12807     15     8       21     30     13     6     0     0     0     0     0     126     15     7	523 1743 8	80				14 10	9	7	2	0	0	0	0	122	0	80	47	13072	709		60
39     17     21     9     3     7     0     0     0     0     0     122     0     7     48     13074     13     8       42     8     30     6     6     1     3     0     0     0     0     122     0     8     49     13075     710     8       3     27     31     6     6     0     0     0     0     126     24     8     4     8959     711     8       22     24     29     1     3     0     0     0     0     122     8     7     11666     712     8       33     24     14     1     0     0     0     0     0     122     8     50     11866     712     8       21     30     13     6     1     0     0     0     0     0     122     3     7     51     122     8       21     30     13     6     1     0 <t< td=""><td>536 1664 9</td><td>0</td><td></td><td></td><td></td><td>0 12</td><td>2 15</td><td>Н</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>124</td><td>0</td><td>7</td><td>15</td><td>13073</td><td>12</td><td></td><td>60</td></t<>	536 1664 9	0				0 12	2 15	Н	0	0	0	0	0	124	0	7	15	13073	12		60
42     8     30     6     6     1     3     0     0     0     0     122     0     8     49     13075     710     8       3     27     31     6     6     0     3     0     0     0     0     0     124     8     4     8959     711     8       22     24     29     14     3     0     0     0     0     124     5     7     16     125.66     14     8       33     24     14     12     2     6     1     0     0     0     0     122     3     7     51     12807     15     8       21     30     13     6     9     6     0     0     0     0     126     15     7     51     12807     15     8       42     16     15     13     4     4     2     0 </td <td></td> <td>10</td> <td></td> <td>0 39</td> <td>17</td> <td>21 5</td> <td>т С</td> <td>7</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>122</td> <td>0</td> <td>7</td> <td>48</td> <td>13074</td> <td>13</td> <td>8.5907</td> <td>10</td>		10		0 39	17	21 5	т С	7	0	0	0	0	0	122	0	7	48	13074	13	8.5907	10
3 27 31     6 6 0     3 0 0 0 0 0 0 126     24 8 4 8959     711     8       33 32     2 9 14     3 0 0 0 0 0 0 124     5 7 16 12526     14 8     8       22 24 29 1 5 6 1 0 0 0 0 0 122     8 8 50 11866     712     8       33 24 14 12 2 8 0 0 0 0 0 0 122     3 7 51 12807     15 8       21 30 13 6 9 6 0 0 0 0 0 126 15     7 5 10631     16 8       42 16 15 13 4 4 2 0 0 0 0 0 0 122     8 52 13076     713     8		11		0 42		30 6	9	-	m	0	0	0	0	122	0	œ	49	13075	710	8.5918	12
33     32     2     9     14     3     0     0     0     0     0     124     5     7     16     1256     14     8       22     24     29     1     5     6     1     0     0     0     0     122     3     7     51     12807     15     8       21     30     13     6     9     6     0     0     0     0     126     15     7     5     10631     16     8       42     16     15     13     0 <t< td=""><td>492 1912 12</td><td>12</td><td></td><td>24 3</td><td>27</td><td>31 6</td><td>9</td><td>0</td><td>m</td><td>0</td><td>0</td><td>0</td><td>0</td><td>126</td><td>24</td><td>œ</td><td>4</td><td>8959</td><td>711</td><td>8.5918</td><td>11</td></t<>	492 1912 12	12		24 3	27	31 6	9	0	m	0	0	0	0	126	24	œ	4	8959	711	8.5918	11
22 24 29 1 5 6 1 0 0 0 0 0 122 8 8 50 11866 712 8. 33 24 14 12 2 8 0 0 0 0 0 0 122 3 7 51 12807 15 8. 21 30 13 6 9 6 0 0 0 0 0 0 126 15 7 5 10631 16 8. 42 16 15 13 4 4 2 0 0 0 0 0 122 0 8 52 13076 713 8.		13		5 33	32	2	14	٣	0	0	0	0	0	124	ß	7	16	12526	14	8.5935	15
33 24 14 12 2 8 0 0 0 0 0 0 122 3 7 51 12807 15 8. 21 30 13 6 9 6 0 0 0 0 0 0 126 15 7 5 10631 16 8. 42 16 15 13 4 4 2 0 0 0 0 0 122 0 8 52 13076 713 8.	490 1830 14	14				29 1	ī.	9	Н	0	0	0	0	122	00	80	20	11866	712	8.5920	13
21 30 13 6 9 6 0 0 0 0 0 0 126 15 7 5 10631 16 8. 42 16 15 13 4 4 2 0 0 0 0 0 122 0 8 52 13076 713 8.	1722 1	15				14 12	2	œ	0	0	0	0	0	122	٣	7	51	12807	15	8.5933	14
42 16 15 13 4 4 2 0 0 0 0 0 122 0 8 52 13076 713 8.	1746	16				13 6	9	9	0	0	0	0	0	126	15	7	S	10631	16	8.5944	19
	509 1725 17	17		- 1		15 13	4	4	7	0	0	0	0	122	0	8	52	13076	713	•	21

k = 26, Designs sorted based on degrees of freedom used

Design	wlp(w4,)	wlp					alp					df	CZFI	df C2FI Lmax	đĘ	CZFI	Lmax	CD2*	CD2	
		rank												-	rank	rank	rank		rank	
26-19,224	468	224	20 31	0 3.	1 8	0 10	0	Н	0	,	0	127	20	6	7	9213	4570	8.6037	370	
26-19,997	528		0 72	0	0	28 (	0	0	0	0	1	127	0	13	7	13371	13476	8.6194	4435	
26-19.5	163 520 1783	'n	15 18	27 1	9 15	0	0	0	0	0	0	126	15	7	٣	10630	6	8.5879	Ŋ	
26-19.12	492	12	24 3	27 3.	1 6	9	3	0	0	0	0	126	24	8	4	8959	711	8.5918	11	
26-19.16	206	16	15 21	30 13	3 6	6	0	0	0	0	0	126	15	7	S	10631	16	8.5944	19	
26-19.48	484	48	24 3	30 34	4	0	9	0	0	0	0	126	24	œ	9	8960	732	8.5999	113	
26-19.49	486		22	20 15	8	7	<u>د</u>	0	0	0	0	126	18	8	7	9448	733	8.5994	87	
26-19.935	418	932	24 21	18 1(	6 0	9	3	0	0	0	0	126	24	80	80	8961	786	8.6102	1197	
26-19.1462	414		18	15 13	3 12	9	9	0	0	0	0	126	27	00	6	1151	791	8.6143	2180	
26-19.1063	416		12	24 24	0	0 13	0	7	0	0	0	125	24	6	10	8962	4949	8.6109	1312	
26-19.1187	192 412 1932	1187	24 14	20 26	0	1 11	٦.	7	0	0	0	125	24	6	11	8963	5004	8.6115	1449	
26-19.1460	194 412 1912	1460	24 18	12 30	0	1 12	0	Н	-	0	0	125	24	10	12	8964	9542	8.6137	2037	
26-19.1	152 568 1704	-1	0 29	41 4	1 16	8	0	0	0	0	0	124	0	9	13	13068	1	8.5797	-1	
26-19.2	155 555 1720	7	5 20	45 6	5 13	10 0	0	0	0	0	0	124	Ŋ	9	14	12525	2	8.5819	2	
26-19.9	164 536 1664	6	0 42	28 0	) 12	15 1	0	0	0	0	0	124	0	7	15	13073	12	8.5900	6	

k=26, Designs sorted based on the number of clear two-factor interactions

26-19,13485         365 70 4138         13485         49         0         0         6         22         3         0         0         106         49         10         13473         2         12014         8.8117           26-19,13486         365 71 4138         13486         49         0         0         0         6         22         3         0         0         106         49         10         13473         2         12015         8.8117           26-19,13487         366         94129         13487         49         0         0         0         9         16         6         0         106         49         10         13474         3         12016         8.8127           26-19,1348         36         70         4129         13487         49         0         0         0         9         16         6         0         106         49         10         13475         4         12017         8.8127           26-19,1349         366         70         4129         13489         49         0         0         0         9         16         0         106         49         1         13476         5	Design	wlp (w4,)	) wlp rank			}				alp							df c	C2FI	Lmax	x df rank	C2FI rank	Lmax rank	CD2*	CD2 rank
13486         49         0         0         0         6         22         3         0         0         106         49         10         13473         2         12015           13487         49         0         0         0         9         16         6         0         0         106         49         10         13474         3         12016           13488         49         0         0         0         9         16         6         0         0         106         49         10         13474         3         12016           13489         49         0         0         0         9         16         6         0         0         106         49         10         13474         3         12016           13490         49         0         0         0         9         16         6         0         0         106         49         10         13476         5         12019           13491         49         0         0         0         0         0         11         13478         6         12019           13492         49         0         0	26-19,13485	365 70 413	15	49	0	0	0	0	0	0	6 2	2	m	0			901	49	10	13472	1	12014	8.8115	13485
13487         49         0         0         0         9         16         6         0         0         106         49         10         13474         3         12016           13488         49         0         0         0         9         16         6         0         0         106         49         10         13475         4         12017           13489         49         0         0         0         9         16         6         0         0         10         49         10         13476         5         12019           13491         49         0         0         0         0         9         16         6         0         0         10         13477         6         12019           13491         49         0         0         0         0         0         11         3         6         1         0         106         49         11         13478         6         12019           13492         49         0         0         0         0         11         3         6         1         0         106         49         11         13489         9 <td>26-19.13486</td> <td>365 71 413</td> <td>_</td> <td>49</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>6 2</td> <td>2</td> <td>m</td> <td>0</td> <td>0</td> <td></td> <td>901</td> <td>49</td> <td>10</td> <td>13473</td> <td>7</td> <td>12015</td> <td>8.8117</td> <td></td>	26-19.13486	365 71 413	_	49	0	0	0	0	0	0	6 2	2	m	0	0		901	49	10	13473	7	12015	8.8117	
13488         49         0         0         0         9         16         6         0         0         106         49         10         13475         4         12017           13489         49         0         0         0         9         16         6         0         0         106         49         10         13476         5         12018           13491         49         0         0         0         9         16         6         0         0         106         49         10         13477         6         12019           13492         49         0         0         0         0         0         11         3         6         1         0         106         49         11         13478         7         13214           13492         49         0         0         0         0         0         0         106         49         11         13489         9         13215           13494         49         0         0         0         0         16         4         9         0         106         49         11         13480         9         13216	26-19,13487	366 69 412	_	49	0	0	0	0	0	0	9	9	9	0	0		901	49	10	13474	e	12016	8.8125	13487
13489         49         0 <td>26-19.13488</td> <td>366 70 412</td> <td>-</td> <td>49</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>9</td> <td>9</td> <td>ဖ</td> <td>0</td> <td>0</td> <td></td> <td>106</td> <td>49</td> <td>10</td> <td>13475</td> <td>4</td> <td>12017</td> <td>8.8127</td> <td></td>	26-19.13488	366 70 412	-	49	0	0	0	0	0	0	9	9	ဖ	0	0		106	49	10	13475	4	12017	8.8127	
13490     49     0     0     0     0     16     6     0     0     106     49     10     13477     6     12019       13491     49     0     0     0     0     11     13     6     1     0     0     106     49     11     13478     7     13214       13492     49     0     0     0     0     11     13     6     1     0     0     106     49     11     13479     8     13215       13493     49     0     0     0     0     16     4     9     2     0     0     106     49     11     13480     9     13216       13494     49     0     0     0     0     16     4     9     2     0     106     49     11     13481     10     13217	26-19,13489	366 70 412	*	49	0	0	0	0	0	0	9 1	9	9	0	0	0	901	49	10	13476	τ.	12018	8.8127	
13491     49     0     0     0     0     11     13     6     1     0     0     106     49     11     13478     7     13214       13492     49     0     0     0     0     11     13     6     1     0     0     106     49     11     13479     8     13215       13493     49     0	26-19,13490	366 71 412	_	•	0	0	0	0	0	0	9 1	9	ø	0	0	0	901	49	10	13477	9	12019	8.8128	
13492 49 0 0 0 0 0 11 13 6 1 0 0 106 49 11 13479 8 13215 13493 49 0 0 0 0 0 16 4 9 2 0 0 106 49 11 13480 9 13216 13494 49 0 0 0 0 0 16 4 9 2 0 0 106 49 11 13481 10 13217	26-19.13491	367 69 412		~	0	0	0	0	0	0	4	ო	9	-	0	C	106	49	11	13478	7	13214	8.8137	
13493 49 0 0 0 0 0 0 16 4 9 2 0 0 106 49 11 13480 9 13216 13494 49 0 0 0 0 0 16 4 9 2 0 0 106 49 11 13481 10 13217	26-19.13492	367 71 412		7	0	0	0	0	0	0	1 1	٣	9	Η.	0	C	901	49	11	13479	80	13215	8,8139	
13494 49 0 0 0 0 0 0 16 4 9 2 0 0 106 49 11 13481 10 13217	26-19,13493	369 68 410	, ,	7	0	0	0	0	0	0	9	4	on.	2	0	C	106	49	11	13480	6	13216	8,8158	
	26-19,13494	369 69 410	•	4.	0	0	0	0	0	0 1	9	4	6	2	0	0	106	49	11	13481	10	13217	8.8160	

k = 26, Designs sorted based on minimizing Lmax

noise	MID	W O [W)	(	wlb						•	alp						df	C2FI Lmax	Lma	x df	_	Lmax	CD2*	CD2
i n				rank							•									rank	rank	rank		rank
6-19.1	152 5	89	1704	1	0	29	41	4	16	8	0		0		0	0	124	0	9	13	13068	1	8.5797	1
2.6		555	1720	2	Ŋ	20	45	Ŋ	13	0	0	0	0	0	0	0	124	z,	9	14	12525	2	8,5819	7
26-19.1862		37	2813	1862	25		8	18	30	2	0	0	0	0	0	0	113	25	Ø	3692	4678	m	8.6050	503
9.2093		35	2795	2093	25	0	10	0	42	0	0	0	0	0	0	0	113	25	9	3733	4680	4	8.6070	742
9.2095a		38	2795	2095	25	0	7		15	6	0	0	0	0	0	0	113	25	9	3736	4682	S	8.6071	765
9.2098		337	2795	2098	25	0	4	18	24	9	0	0	0	0	0	0	113	25	9	3738	4685	9	8.6073	784
9.2612b		231	2779	2612	25	0	10		18	22	0	0	0	ر د	0	0	113		9	3883	4751	7	8.6113	1387
9.3		530	1767	m	0	30	30	20	9	ഗ	Ŋ	0	0	c	C	0	122	0	7	43	13069	œ	8.5854	ო
1.0		520	1783	Ŋ	15	138	27	19	15	0	9	0	0	0	0	0	126	15	7	က	10630	6	8.5879	S
26-19.6	163 523 1752	523	1752	9	0	36	19	25	9	4	9	0	0	0	0	0	122	0	7	45	13071	10	8.5880	9

k = 26, Design generators

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	_	13		37	41	σ	S		11	æ		91	97	98	_	116	12	125	
7 11	_	5		38	47	25	57		69	73		82	84	93	~	86		120	
11		13		21	31	œ	-		29	0		81	91	66	-4	106	Ξ	120	
11	_	9		37	41	0	S		11	œ		87	91	66	•	106	Ξ	120	
11	_	9		32	38	-	4		25	6		92	92	100	~	113	12	125	
11	_	ø,		37	41	4	6		9/	2		94	66	106		117	1	120	
11	_	9	• •	32	38	Н			55	б		82	92	95	$\overline{}$	103	12	125	
7 11		13	• •	37	41	4	ß		11	80		87	91	66	•	106	급	~	
7 11 3	_	5	•	35	46	53			66	e		82	87	100	-	118	12	123	
7 11 1	Ξ	9		37	41	44	55		73	ø		87	100	103		113	12	N	
7 11	_	19	• •	35	38	41 ,			25	6		82	92	95	-	100	12	125	
		9	٠,	35	37	8				6		84	104	112		122	12	~	
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•	•	Θ.	• •	37	41	44				m		87	100	103		113	12	125	
7 11 1		6		38	41	۲.				Φ.		66	106	108		116	12	123	
Π.	Π.	4	٠.	35	37	8	Н			•		83	90	95		106	1	2	
_	_	9	٠,	30	35	_	38 4			_		69	73	76		116	12	125	
-	-	9		35	37	00						73	92	95	_	113	12	125	
_	_	9	.,	28	38	~	7			m		82	84	93		108	11	120	
_	_	3	• •	26	47				_	_		107	109	112		122	12	127	
_	_	6	. 4	22	25	9	m					29	77	78		118	12	123	
_	_	3	_	19	38	7	0					. 901	113	114		120	12	126	
		n	_	25	56	_	m					26	86	104		121	12	124	
		σ.	"	30	38	_	7			٥,		87	66	101		122	12	127	
		6	(1	37	38	_	O.			٠,		78	82	89		111	11	120	
		$\exists$	14	35	37		ο.			_		00	103	104		121	12	124	
		Ξ.	"	32	37	-	Δ1					86.1	007	104		121	12	124	
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		21	"	35		_	^1			_		00	103	104		121	122	124	
		22	$\epsilon a$	31		9	_			_		03	104	601		121	122	124	
19		21	(1	35		œ	•			_		81	87	97		111	112	115	
19		21	(1	35		38 4				_		81	87	4		111	112	115	
19		7	(/	35		·	σ			_		81	82	87		111	112	115	
19		21	~	35		38 6	7		н			92	86	001		112	117	118	
19		21	~	35		·	σ		2	_		70	81	87		111	112	115	
19		21	1	35		38 4	σ		7	_		81	84	86		117	118	123	
19		21	0	35		80	6	_	7	_		81	82	87		111	112	115	
7 19		21	22	35	37	38 4	9 5	50 5	2	67	81	82	87	92	100	103	112	115	
13		11	$^{\circ}$	35		38 4		_	7	_		81	82	84		6	111	112	
13		-	$^{\circ}$	35		38 4		_	6	_		82	84	87		111	112	118	

k = 27, Designs sorted based on word length pattern

7696 7697 7698 7699 7699 7316	000000000000000000000000000000000000000											
	76.77	7696 7698 7698 7699 7701 7316 7316	7696 7697 7699 7699 7701 7316 7702 5505									7696 1326 13698 137699 1326 1326 132701 132702 1328 1328 1328 1329 1499 15094 1329 1332 1332 1332 1332 1332 1332 1332
19 20 22 8	19 76 7 76 20 76 20 76 22 77 8 73			19 7697 7 7698 20 7699 22 7701 8 7316 23 7702 1 5505 24 7703								
7 8 8 8 7 7					r ∞ ∞ ∞ r σ σ ∞ ω		1008870008887	<ul><li>∠ ⊗ ⊗ ⊗ ∠ ⊘ ⊘ ⊗ ⊗ ⊗ ⊘ ⊘ ⊗</li><li>∠ ⊗ ⊗ ⊗ ∠ ⊘ ⊘ ⊗ ⊗ ⊗ ⊘ ⊘ ⊗</li></ul>	L 8 8 8 L Q Q 8 8 Q Q Q Q Q Q Q Q Q Q Q	L 8 8 8 L 9 9 8 8 8 9 0 8 9 9		L 8 8 8 L 9 9 8 8 8 9 0 8 9 9 9 9
123 0 123 0 123 0 125 5												123 0 123 0 123 0 125 5 123 0 127 24 123 0 127 15 127 15 128 10 125 20 125 20 125 20 121 8 121 8
3 9 35 9 0 7 3 0 0 0 0 0 123 0 18 26 12 0 7 3 0 0 0 0 0 0 123 3 15 24 14 0 6 4 0 0 0 0 0 123 0 45 0 7 11 10 0 0 0 0 0 0 125	3 0 0 0 0 0 123 4 0 0 0 0 0 123 0 0 0 0 0 125 0 2 0 0 0 0 123	3 0 0 0 0 0 123 0 0 0 0 0 0 123 0 0 0 0 0 0 125 0 0 0 0 0 125 0 0 0 0 0 125	12 0 7 3 0 0 0 0 123 14 0 6 4 0 0 0 0 123 7 11 10 0 0 0 0 0 125 15 1 8 0 2 0 0 0 125 0 12 0 0 3 0 0 0 127 16 0 5 5 0 0 0 0 123	12 0 7 3 0 0 0 0 0 123 14 0 6 4 0 0 0 0 123 7 11 10 0 0 0 0 0 125 15 1 8 0 2 0 0 0 0 125 0 12 0 0 3 0 0 0 0 127 16 0 5 5 0 0 0 0 0 123 18 0 4 6 0 0 0 0 123	12 0 7 3 0 0 0 0 0 123 14 0 6 4 0 0 0 0 0 123 7 11 10 0 0 0 0 0 125 15 1 8 0 2 0 0 0 0 125 0 12 0 0 3 0 0 0 0 127 16 0 5 5 0 0 0 0 0 123 18 0 4 6 0 0 0 0 0 123 0 15 0 6 0 0 0 123	12 0 7 3 0 0 0 0 123 14 0 6 4 0 0 0 0 0 123 7 11 10 0 0 0 0 0 125 15 1 8 0 2 0 0 0 0 125 16 0 5 5 0 0 0 0 123 18 0 4 6 0 0 0 0 0 123 19 0 6 0 0 0 0 123 15 0 7 0 3 0 0 0 123	12 0 7 3 0 0 0 0 123 14 0 6 4 0 0 0 0 123 7 11 10 0 0 0 0 0 123 0 12 0 0 3 0 0 0 0 123 18 0 2 0 0 0 0 123 18 0 4 6 0 0 0 0 123 0 15 0 6 0 0 0 123 28 6 0 0 2 1 0 0 123	12 0 7 3 0 0 0 0 123 14 0 6 4 0 0 0 0 0 123 7 11 10 0 0 0 0 0 123 15 1 8 0 2 0 0 0 0 123 16 0 5 5 0 0 0 0 123 18 0 4 6 0 0 0 0 123 19 0 6 0 0 0 123 15 0 6 0 0 0 123 16 0 7 0 3 0 0 0 123 17 10 2 3 7 0 0 0 0 123	10 0 0 0 0 0 0 123 10 0 0 0 0 0 0 123 10 0 0 0 0 0 0 123 10 0 0 0 0 0 123 10 0 0 0 0 0 123 10 0 0 0 0 123 10 0 0 0 0 123	10 0 0 0 0 0 0 123 10 0 0 0 0 0 0 123 10 0 0 0 0 0 0 123 10 0 0 0 0 0 123 10 0 0 0 0 123 10 0 0 0 0 123 10 0 0 0 0 123	10 0 0 0 0 0 0 123 10 0 0 0 0 0 0 123 10 0 0 0 0 0 0 123 10 0 0 0 0 0 123 10 0 0 0 0 0 123 10 0 0 0 0 123	3 0 0 0 0 0 123 3 0 0 0 0 0 123 0 2 0 0 0 0 123 0 3 0 0 0 0 123 6 0 0 0 0 0 123 6 0 0 0 0 0 123 6 0 0 0 0 0 123 7 0 0 0 0 0 123 0 2 1 0 0 0 0 123 7 0 0 0 0 123 8 0 0 0 0 123 9 1 0 0 0 123 9 1 0 0 0 0 123 9 2 1 0 0 0 0 123 9 3 4 0 0 0 0 124 9 3 4 0 0 0 0 114
4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	4     0     0     0     0     123     0       0     0     0     0     0     125     5       0     2     0     0     0     123     0	14     0     6     4     0     0     0     0     123     0       7     11     10     0     0     0     0     125     5       15     1     8     0     2     0     0     0     123     0       0     12     0     3     0     0     0     127     24	14     0     6     4     0     0     0     123     0       7     11     10     0     0     0     0     125     5       15     1     8     0     2     0     0     0     123     0       0     12     0     3     0     0     0     127     24       16     0     5     5     0     0     0     123     0	14     0     6     4     0     0     0     0     123     0       7     11     10     0     0     0     0     0     125     5       15     1     8     0     2     0     0     0     123     0       0     12     0     0     0     0     0     127     24       16     0     5     5     0     0     0     0     123     0       18     0     4     6     0     0     0     0     123     3	14         0         6         4         0         0         0         0         123         0           7         11         10         0         0         0         0         125         5           15         1         8         0         2         0         0         0         123         0           0         12         0         0         0         0         0         127         24           18         0         4         6         0         0         0         123         0           0         15         6         0         0         0         123         3           0         15         0         0         0         0         123         3	14         0         6         4         0         0         0         0         123         0           7         11         10         0         0         0         0         125         5           15         1         8         0         2         0         0         0         123         0           0         12         0         0         0         0         127         24           16         0         5         5         0         0         0         123         0           0         15         6         0         0         0         0         123         3           0         15         0         0         0         0         123         3           1         0         6         0         0         0         0         123         3           1         0         7         0         3         0         0         0         0         123         0	14     0     6     4     0     0     0     0     123     0       7     11     10     0     0     0     0     0     125     5       15     1     8     0     2     0     0     0     123     0       0     12     0     0     3     0     0     0     127     24       18     0     4     6     0     0     0     0     123     0       15     0     6     0     0     0     0     123     3       15     0     0     0     0     0     123     3       28     6     0     0     0     0     125     20	14     0     6     4     0     0     0     0     123     0       7     11     10     0     0     0     0     0     125     5       10     12     0     0     0     0     0     123     0       16     0     5     5     0     0     0     0     123     0       18     0     4     6     0     0     0     0     123     3       0     15     0     0     0     0     0     123     3       15     0     0     0     0     0     123     3       28     6     0     0     0     0     123     0       10     2     1     0     0     0     123     0       10     2     1     0     0     0     123     0	6 4 0 0 0 0 0 123 0 120 0 0 0 0 0 125 5 9 0 0 0 0 0 125 5 9 0 0 0 0 0 123 0 0 0 0 0 123 0 0 0 0 0 123 0 0 0 0 0 0 123 0 0 0 0 0 0 0 0 123 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	6 4 0 0 0 0 123 0 10 0 0 0 0 125 5 8 0 2 0 0 0 123 0 0 0 3 0 0 0 123 0 5 5 0 0 0 0 123 2 4 6 0 0 0 0 123 3 0 6 0 0 0 0 123 3 0 7 0 0 0 0 123 15 0 8 0 0 0 0 123 0 1 15 0 0 0 0 123 0	10 0 0 0 0 0 123 0 125 5 8 0 0 0 0 0 125 5 5 8 0 0 0 0 0 127 24 6 0 0 0 0 0 127 15 7 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	4       0       0       0       0       123       0         0       0       0       0       0       125       5         0       2       0       0       0       123       0         0       3       0       0       0       127       24         5       0       0       0       0       123       3         6       0       0       0       0       123       3         6       0       0       0       0       123       3         0       2       1       0       0       123       8         0       2       1       0       0       123       8         0       3       0       0       0       123       8         0       3       0       0       0       125       18         0       3       0       0       0       124       0         0       0       0       0       0       125       18         0       0       0       0       0       114       0         0       0       0       0
0 0 0 0 0	0 0 0 0 0 0 0 125 5	7 11 10 0 0 0 0 0 0 125 5 15 1 8 0 2 0 0 0 0 123 0 0 12 0 0 3 0 0 0 0 127 24	7 11 10 0 0 0 0 0 0 125 5 15 1 8 0 2 0 0 0 0 123 0 0 12 0 0 3 0 0 0 0 127 24 16 0 5 5 0 0 0 0 0 123 0	7 11 10 0 0 0 0 0 0 125 5 15 1 8 0 2 0 0 0 0 123 0 0 12 0 0 3 0 0 0 0 127 24 16 0 5 5 0 0 0 0 0 123 0 18 0 4 6 0 0 0 0 0 123 3	7     11     10     0     0     0     0     125     5       15     1     8     0     2     0     0     0     0     123     0       0     12     0     0     0     0     0     127     24       16     0     5     5     0     0     0     0     123     0       18     0     4     6     0     0     0     0     123     3       0     15     0     0     0     0     123     3	7 11 10 0 0 0 0 0 125 5 0 12 0 0 3 0 0 0 0 127 24 16 0 5 5 0 0 0 0 123 0 18 0 4 6 0 0 0 0 123 3 0 15 0 6 0 0 0 123 3 1 0 7 0 3 0 0 0 123 3	7     11     10     0     0     0     0     125     5     7       15     1     8     0     2     0     0     0     123     0     9       0     12     0     0     3     0     0     0     127     24     9       16     0     5     5     0     0     0     0     123     0     8       18     0     4     6     0     0     0     0     123     3     8       15     0     7     0     3     0     0     0     123     0     9       28     6     0     0     2     1     0     0     125     20     10	7     11     10     0     0     0     0     125     5     7       15     1     8     0     2     0     0     0     123     0     9       0     12     0     0     3     0     0     0     127     24     9       16     0     5     5     0     0     0     123     0     8       18     0     4     6     0     0     0     123     3     8       15     0     6     0     0     0     0     123     0     9       28     6     0     0     0     0     123     0     9       28     6     0     0     0     0     125     20     10       10     2     3     7     0     0     0     0     123     8     8	10 0 0 0 0 0 0 0 125 5 7 8 0 0 0 0 0 123 0 9 0 0 0 0 127 24 9 0 0 0 0 127 24 9 0 0 0 0 127 24 9 0 0 0 0 123 0 12 0 0 0 0 0 123 0 12 0 0 0 0 0 123 0 12 0 0 0 0 0 125 20 10 0 0 0 0 125 20 10 0 0 0 0 0 125 20 10 0 0 0 0 0 125 18 9 0 0 0 0 0 125 18 9	10 0 0 0 0 0 0 0 125 5 7 8 0 0 0 0 0 123 0 9 0 0 0 0 127 24 9 0 0 0 0 127 24 9 0 0 0 0 127 24 9 0 0 0 0 0 123 0 8 0 0 0 0 0 123 0 8 0 0 0 0 0 123 18 8 0 0 0 0 0 123 18 18 0 0 0 0 0 0 125 18 9 0 0 0 0 0 125 18 9 0 0 0 0 0 121 8 9	10 0 0 0 0 0 0 125 5 7 8 0 0 0 0 123 0 9 0 0 0 0 123 0 9 0 0 0 0 127 24 9 0 0 0 0 0 127 24 9 0 0 0 0 123 0 0 8 0 0 0 0 0 123 0 0 8 0 0 0 0 0 123 0 0 9 0 0 0 0 0 123 0 0 9 0 0 0 0 0 123 0 0 9 0 0 0 0 0 125 18 9 0 0 0 0 0 0 125 18 9 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 125 5 7 0 2 0 0 0 0 0 123 0 9 0 2 0 0 0 0 127 24 9 0 0 0 0 0 127 24 9 0 0 0 0 0 127 24 9 0 0 0 0 0 127 15 8 0 0 0 0 0 0 127 15 8 0 0 0 0 0 123 0 9 0 0 1 1 0 0 0 125 20 10 0 0 0 0 0 125 8 8 0 0 0 0 0 0 125 8 8 0 0 0 0 0 0 125 18 9 0 0 0 0 0 125 18 9 0 0 0 0 0 125 18 9 0 0 0 0 0 127 18 9 0 0 0 0 0 127 18 9 0 0 0 0 0 127 18 9 0 0 0 0 0 127 18 9 0 0 0 0 0 127 18 9 0 0 0 0 0 127 18 9
	123 0	15 1 8 0 2 0 0 0 0 123 0 9 0 12 0 0 0 0 0 127 24 9	15 1 8 0 2 0 0 0 0 123 0 9 0 12 0 0 0 12 0 0 12 0 0 12 0 12 0	15     1     8     0     2     0     0     0     0     123     0     9       0     12     0     0     3     0     0     0     0     127     24     9       16     0     5     5     0     0     0     0     123     0     8       18     0     4     6     0     0     0     0     123     3     8	15     1     8     0     2     0     0     0     0     123     0     9       0     12     0     0     3     0     0     0     0     127     24     9       16     0     5     5     0     0     0     0     123     0     8       18     0     4     6     0     0     0     0     123     3     8       0     15     0     6     0     0     0     0     127     15     8	15     1     8     0     2     0     0     0     0     123     0     9       16     0     5     5     0     0     0     0     127     24     9       18     0     5     5     0     0     0     0     123     0     8       18     0     4     6     0     0     0     0     123     3     8       0     15     0     6     0     0     0     0     127     15     8       15     0     7     0     3     0     0     0     0     123     0     9	15     1     8     0     2     0     0     0     123     0     9       0     12     0     0     3     0     0     0     0     127     24     9       16     0     5     5     0     0     0     0     123     2     8       18     0     4     6     0     0     0     0     123     3     8       15     0     0     0     0     0     123     0     9       28     6     0     0     2     1     0     0     125     20     10	15     1     8     0     2     0     0     0     123     0     9       16     0     5     5     0     0     0     0     127     24     9       18     0     4     6     0     0     0     123     3     8       0     15     0     6     0     0     0     123     3     8       15     0     6     0     0     0     0     123     0     9       28     6     0     2     1     0     0     123     0     9       10     2     3     7     0     0     0     0     125     20     10       10     2     3     7     0     0     0     0     123     8     8	8 0 2 0 0 0 0 123 0 9 9 0 0 0 127 24 9 5 5 0 0 0 0 0 127 24 9 6 0 0 0 0 123 0 8 6 6 0 0 0 0 123 3 8 6 6 0 0 0 0 0 123 15 8 6 6 0 0 0 0 0 123 15 8 6 6 0 0 0 0 0 123 15 15 15 15 15 15 15 15 15 15 15 15 15	8 0 2 0 0 0 0 123 0 9 9 0 0 0 127 24 9 5 5 0 0 0 0 0 0 127 24 9 6 0 0 0 0 123 0 8 8 6 0 0 0 0 123 3 8 8 6 0 0 0 0 0 123 3 8 8 6 0 0 0 0 0 123 15 8 6 0 0 0 0 0 125 18 9 9 0 0 0 0 125 18 9 9 0 0 0 0 0 125 18 9 9 0 0 0 0 0 121 8 9	8 0 2 0 0 0 0 123 0 9 9 0 0 0 127 24 9 0 0 0 0 0 127 24 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	123 0 9 127 24 9 123 0 8 123 0 8 123 0 9 125 20 10 125 20 10 125 18 9 125 18 9 114 0 9 64

k=27, Designs sorted based on degrees of freedom used

CD2	rank	6	17	29	2110	2635	Н	ς.	ω	16	19
CD2*		7.7950	7.7992	7.8022	7.8195	7.8212	7.7798	7.7920	7.7948	7.7992	7.7993
Lmax	rank	1328	16	1337	1425	4315	1	٣	4	3728	1330
CZFI	rank	5505	5934	5506	5507	5508	7696	7698	7316	5541	5651
ď£	rank	Н	2	က	4	S	9	7	ω	თ	10
Lmax	អ័	6	œ	თ	6	10	9	7	7	10	0
CZFI		24	15	24	24	24	0	0	Ŋ	20	18
df C		127	127	127	127	126	125	125	125	125	125
		0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0
		0	0	0	0	2	0	0	0	Н	0
		m	0	m	ო	0	0	0	0	7	m
alp		0	9	9	9	12	0	0	0	0	0
ø		0	0		0		0		10	0	0
		1			18		16				13
		0	0	0	0	0		4		8	82
		15	24	51	15	98	0	0	0	9	თ
		91	22	91	16	12	55	11	5	33	8
		0 16	18		18						
		1	15 1		24 1			0	r)		18
		10		(1	(V	(1				.,	
wlp	rank				1023					14	
7		2488	2279	2416	2576	2543	2200	2152	2172	2488	210 546 2512
Wlp (W4,)		88	92	08	84	72	06	46	30	99	46
Mlp	•	2 5	7 5	2	4	7	9	9	9	8	0 5
		20	20	21	23	23	18	19	20	20	21
Design		27-20.9									27-20.16

k = 27, Designs sorted based on the number of clear two-factor interactions

Design	wlp	wlp (w4,)	-	wlp rank							alp	Ω						df C	2FI	C2FI Lmax	x df rank	C2FI rank	Lmax rank	CD2*	CD2 rank
27-20.8067	435 8		5440	8067	51	0	0	0	0	0	0	0	0 2		٦		1	960	51	10	8029	1	6112	8.0318	8067
27-20.8068	435 80		5440	8068	51	0	0	0	0	0	0	0	0 2	1	0	0	Ť.	109	51	10	8030	2	6113	8.0319	8908
27-20.8069	436 7		430	8069	51	0	0	0	0	0	0	0 1	3	S)	8	0	H	60	51	11	8031	e	7511	8.0327	8069
27-20.8070	436 8		430	8070	51	0	0	0	0	0	0	0	3	N (i)	ص ھ	0	1	60	51	11	8032	4	7512	8.0329	8070
27-20.8071	437 7		422	8071	51	0	0	0	0	0	0	0 1	9	9	2	0	1	60	51	11	8033	S	7513	8.0337	8071
27-20.8072	437 7		422	8072	51	0	0	0	0	0	0	0	G	9	9	0	F	60	51	11	8034	9	7514	8.0338	8072
27-20.8073	438 7		412	8073	51	0	0	0	0	0	0	0	œ	9	5	0	ī	60	51	12	8035	7	7994	8.0347	8073
27-20.8074	438 8(	80 54	412	8074	51	0	0	0	0	0	0	0 1	18	5	5 1	0	1	60	51	12	8036	00	7995	8.0349	8074
27-20.8075	442 7		376	8075	51	0	0	0	0	0	0	0	4	0		0	1(	60	51	12	8037	6	9662	8.0385	8075
27-20.8042	374 1	141 44	468	8042	38	18	0	0	0	0	0	6 2	, H	<b>.</b>	0	0	1	14	38	10	7690	10	9019	7.9572	8042

k = 27, Designs sorted based on minimizing Lmax

Design	wlp (w4,)	(	wlp rank		_					alp	Q,					df	CZF	Lma	df C2FI Lmax df rank	C2FI rank	Lmax rank	cD2*	CD2 rank
27-20.1	180	690 2200	1	0	0 15	55	0	12 1	9	0	0	0	0	0	0	125	0	9	9	7696	1	7.7798	
27-20.1043	235	280 3647	1043	26	0	0	10 ;	27 2	S	0	0	0	0	0	0	115	26	9	1650	2152	2	7,8063	252
27-20.3	196	2152	ო	0	59	41	0	4 1	00	S	0	0	0	0	0	125	0	7	7	7698	٣	7.7920	S
27-20.7	200	2172	7	5	20	45	0	7 1	1 1	0	0	0	0	0	0	125	S	7	00	7316	4	7,7948	80
27-20.1192	237	3632		56	0	0	13 ;	24 2	22	3	0	0	0	0	0	115	26	7	1651		ß	7,8082	378
27-20.1235	238	3624		56	0	Н	10	30 1	15	S S	0	0	0	0	0	115	26	7	1652		9	7.8091	437
27-20.1298b	239	3616		56	0	0	16 ;	21 1	19 (	0	0	0	0	0	0	115	26	7	1655		7	7.8100	490
27-20.1298a	239	3616		56	0	7	11 2	24 2	0	0	0	0	0	0	0	115	26	7	1655		7	7.8100	490
27-20.1300	239 276	3619	1300	26	0	0	16 2	21 1	6	0	0	0	0	0	0	115	26	7	1657		o,	7.8100	497
27-20.1301	239 277	3614	• •	26	0	П	14 2	1 2	-, H	0	0	0	0	0	0	115	26	7	1658		10	7,8101	499

27-20.1         7 11 19 30 38 47 52 57 58 69 73 79 82 84 93 97 98 108 119 120           27-20.3         7 11 19 29 30 38 41 49 60 78 82 87 91 97 98 100 109 118 120           27-20.4         7 11 19 29 37 03 84 14 96 07 78 82 87 94 99 100 109 118 120           27-20.4         7 11 19 29 37 03 84 14 96 07 78 82 84 99 97 98 100 109 118 120           27-20.4         7 11 19 29 30 38 41 49 60 78 82 84 99 97 98 100 109 118 120           27-20.4         7 11 19 29 30 38 41 45 56 59 67 73 76 82 84 99 90 100 111 171 118 120           27-20.9         7 11 19 29 37 41 44 50 55 59 67 73 76 85 86 91 90 100 100 118 120           27-20.9         7 11 19 29 37 41 44 50 55 59 67 73 76 85 86 91 91 91 91 101 111 111 118 120           27-20.1         7 11 19 29 37 41 44 50 55 59 67 70 73 76 82 84 99 106 111 117 118 120           27-20.1         7 11 19 29 37 41 44 50 55 56 97 37 66 97 38 84 99 100 103 120 120           27-20.1         7 11 19 29 37 41 44 50 55 67 69 77 37 69 81 91 101 118 120 101 118 120           27-20.1         7 11 19 29 30 41 50 67 69 74 76 79 91 101 101 118 120 101 118 120           27-20.1         7 11 19 29 30 31 41 44 50 55 67 69 70 79 91 101 118 120 101 118 120           27-20.1         7 11 19 29 30 31 44 45 55 57 60 70 39 70 81 91 101 118 120         8 11 111 118 118 120           27-20.1         7 11 19 29 30 37 38 44 55 57 60 70 39 69 101 101 101 111 113 113 110 110 110 110	Design								Design	gn (	Generators	rato	rs							
7 11 19 29 37 41 49 56 55 59 77 78 87 91 97 98 101 116 120 119 120 30 38 41 49 66 78 82 84 87 91 97 98 100 109 118 119 120 30 37 38 41 49 56 55 59 77 78 87 91 97 98 100 109 118 119 120 30 37 34 44 45 56 69 70 73 79 82 84 99 106 111 17 118 119 120 37 41 44 50 65 59 62 73 76 85 86 91 99 106 111 17 118 119 120 37 41 44 50 65 59 62 73 76 85 86 91 99 106 111 17 118 119 120 37 41 44 50 65 59 62 73 76 85 86 91 99 102 120 120 120 120 120 120 120 120 120	27-20.1	7 11	19	ω c	1	52	57	58	69	73					100	98	108	119	120	
7         11         19         29         30         8         41         49         60         78         82         84         91         91         91         10         10         11         19         29         37         41         49         60         70         73         79         88         91         90         100         10         11           7         11         19         29         37         41         44         50         55         59         62         73         76         85         86         91         99         106         111         11         11         11         92         37         41         44         50         56         86         97         91         94         99         106         111         11         11         11         11         11         93         37         41         44         50         56         69         73         76         88         91         91         91         91         91         91         91         91         91         91         91         91         91         91         91         91         91         91	27-20.3	7 11	1 1	1 (1		49	20	55	59	77					86	111	116	120	125	
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7 11 19 29 37 41 44 59 69 73 76 82 87 94 99 106 111 117 118 1119 119 29 37 41 44 50 55 89 62 73 76 82 89 89 19 91 102 120 120 120 120 120 120 120 120 12	27-20.4b	7 11	19	7		38	41	49	09						86	100	109	118	120	
7 111 9 30 38 47 52 57 58 69 70 73 79 82 84 93 97 98 119 7 111 13 14 19 29 37 41 44 50 75 86 69 82 84 91 93 105 108 113 119 120 7 111 13 14 19 29 37 41 44 59 73 76 82 87 91 94 99 106 111 117 118 1 1 1 13 14 19 29 37 38 41 44 50 73 76 82 87 91 94 99 106 111 117 118 1 1 1 19 29 37 38 41 44 50 73 76 82 87 91 94 99 106 111 117 118 1 1 1 19 29 37 38 41 44 50 73 76 89 81 101 102 104 101 116 120 123 1 7 11 13 14 19 21 22 35 38 41 49 60 7 69 7 70 89 9 100 111 117 118 1 7 11 19 29 30 34 15 64 7 65 7 69 7 69 7 70 89 9 101 116 120 123 2 7 11 13 14 19 21 22 37 38 41 45 6 7 69 7 69 7 70 89 9 101 111 113 119 120 2 8 7 11 19 29 30 35 73 84 44 55 57 70 73 74 92 97 98 103 117 118 3 8 7 11 19 29 30 37 38 44 55 57 70 73 74 92 97 98 103 117 118 3 8 7 11 19 29 30 37 38 44 55 57 70 73 74 92 97 98 103 117 118 3 8 7 11 19 29 30 37 38 44 55 57 70 73 74 92 97 98 103 117 118 3 8 7 11 19 29 30 37 38 44 55 57 70 73 74 92 97 98 103 117 118 3 8 7 11 19 29 30 37 38 44 55 57 70 73 74 92 97 98 103 117 118 3 8 7 11 13 14 19 21 25 37 38 41 55 60 60 60 60 60 60 60 60 60 60 60 60 60	27-20.6	7 11	19	7		44	59	69	73						106	111	117	118	120	
7 111 19 29 37 41 44 50 55 59 62 73 76 85 86 91 99 102 120  7 111 13 14 19 29 37 41 44 50 58 69 82 84 91 93 105 108 113 119 120  7 111 13 14 19 29 35 37 38 41 44 50 55 69 73 82 95 105 103 120  8 7 11 19 19 29 37 38 41 44 50 55 69 73 82 84 93 97 103 103 120  9 7 11 19 20 30 31 41 50 51 50 51 69 70 73 79 82 84 93 97 101 116 120 123  9 7 11 19 20 30 31 41 50 51 50 51 70 73 79 82 84 93 97 103 103 120  1 7 11 19 20 30 31 41 50 51 50 51 70 73 79 82 84 93 97 103 103 120  1 7 11 19 20 30 31 51 51 51 51 51 51 51 51 51 51 51 51 51	27-20.7	7 11	19	m		52	57	58							93	97	86	44	120	
7 11 13 14 19 38 47 57 58 69 82 84 91 93 105 108 113 119 120 7 11 19 29 37 41 44 59 73 76 87 91 94 93 105 108 113 119 118 7 11 19 29 37 38 47 52 57 69 70 73 79 82 84 93 97 98 110 110 119 110 110 110 110 110 110 110	27-20.8	7 11	19			44	20	55							91	66	102	П	125	
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7.11         7 11         9 29 35 37 38 41 44         50         55         69         73         82         92         95         100         103         110           7.12         7 11         13         30         38         47         52         76         9         70         89         97         101         11         11         11         11         13         29         37         86         88         101         102         104         107         112         115         120         120         11         11         11         11         11         11         12         29         37         86         88         101         102         104         107         112         11         11         12         29         37         38         44         55         57         70         73         74         92         97         98         101         10         11         11         11	7-20	7 11	19			44	59	73							106	111	117	-	120	
1.1.2         7         1.1.2         7         7         9         8         4         9         9         9         9         9         10         11.2           1.1.3         7         11         13         13         14         9         15         15         79         8         9         9         9         9         10         11.5           1.1.4         7         11         19         29         37         38         41         45         6         69         70         89         97         10         11.5         12	-20	7 11	19			38	41	44							95	100	103		125	
7.11         14         19         21         23         3         47         62         73         76         79         81         101         116         120         123         13         14         95         63         77         86         88         101         102         104         107         112         115         121         122         13         103 </td <td>-20</td> <td>7 11</td> <td>19</td> <td></td> <td></td> <td>52</td> <td>57</td> <td>69</td> <td>70</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>97</td> <td>98</td> <td>110</td> <td>٠.</td> <td>120</td> <td></td>	-20	7 11	19			52	57	69	70						97	98	110	٠.	120	
1.14         7         11         9         9         4         5         6         8         101         102         104         107         112         115         11         11         9         9         7         10         10         11         11         10         29         37         38         41         44         50         5         6         9         7         10         11         11         12         12         12         22         33         38         41         45         5         6         7         9         10         11         11         11         11         11         11         11         11         12         23         33         44         5         5         7         7         7         4         9         9         11         11         11         11         11         12         23         33         44         5         5         7         7         4         9         9         9         9         9         9         9         11         11         11         11         11         11         12         23         34         5         7	7-2	7 11	13			22	35	38	47						101	116	120	٠.	125	
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7. 17	7	7 11	19				44	20	52						103	109	118		123	
7         11         13         14         19         21         22         41         50         61         73         74         92         97         98         101         11         11         11         13         11         13         11         11         13         11         13         11         13         13         14         55         57         70         73         74         92         97         98         101         12         2         6         6         6         6         6         6         6         6         6         6         6         9         9         10         11         11         11         11         11         11         11         11         11         11         11         11         11         11         11         11	27-20.16	7 27	29				41	49	67						112	121	122		127	
7 11 19 29 30 37 38 44 55 57 70 73 74 92 97 98 103 117 118 119 29 30 37 38 44 52 57 60 67 69 73 82 92 98 111 119 119 29 30 37 38 44 52 57 70 73 74 92 97 98 103 117 118 119 29 30 35 37 38 44 52 57 70 73 74 92 97 98 103 117 118 113 21 26 47 51 54 78 81 100 104 107 109 112 117 121 122 124 11 12 12 6 35 37 41 52 59 61 74 79 86 100 103 104 112 121 122 124 11 12 12 6 35 37 41 52 59 61 74 79 86 100 103 104 112 121 122 124 122 124 123 124 12 12 12 12 12 12 12 12 12 12 12 12 12	27-20.17	7 11	13				41	20	61						111	113	119		126	
7.11         19         29         30         5         45         53         54         57         60         67         69         73         82         92         98         111         119           0.20         7         11         19         29         30         37         38         44         52         57         70         73         74         92         97         98         111         118           0.1023         7         11         12         26         47         51         54         78         86         100         103         104         112         12         11         12         26         35         37         41         52         59         61         100         103         104         112         12         12         12         12         13         14         52         59         74         79         86         100         103         104         112         12         12         12         14         52         59         74         79         86         100         103         104         112         12         12         12         12         12	27-20.18a	7 11	19				44	55	57						86	103	117		120	
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7-20.8068 7 19 21 22 35 37 38 49 52 67 69 70 81 87 97 98 100 111 112 7-20.8069 7 19 21 22 35 37 38 49 50 52 67 69 70 81 87 97 98 111 112 7-20.8070 7 19 21 22 35 37 38 49 50 67 69 70 81 82 87 97 100 111 112 7-20.8071 7 19 21 22 35 37 38 49 50 67 69 70 81 82 84 87 97 101 111 112 7-20.8072 7 19 21 22 35 37 38 49 50 67 69 70 81 82 84 87 97 111 112 7-20.8073 7 19 21 22 35 37 38 49 50 67 69 70 81 82 84 87 97 101 111 112 7-20.8073 7 19 21 22 35 37 38 49 50 52 67 69 70 81 82 84 87 97 111 112 7-20.8074 7 19 21 22 35 37 38 49 55 67 69 70 81 82 84 87 112 117 118 7-20.8074 7 19 21 22 35 37 38 49 50 52 55 67 69 84 87 100 103 105 115	7-20.	7 19		22			49	52	67					97	86	111	112	115	117	
7-20,8069 7 19 21 22 35 37 38 49 50 52 67 69 70 81 87 97 98 111 112 7-20,8070 7 19 21 22 35 37 38 49 50 67 69 70 81 82 87 97 100 111 112 7-20,8071 7 19 21 22 35 37 38 49 50 67 69 70 81 82 84 87 97 101 111 112 7-20,8072 7 19 21 22 35 37 38 49 50 67 69 70 81 82 84 87 97 111 112 7-20,8073 7 19 21 22 35 37 38 49 50 67 69 70 81 82 84 87 97 101 111 7-20,8073 7 19 21 22 35 37 38 49 50 57 69 70 81 82 84 87 97 111 113 7-20,8074 7 19 21 22 35 37 38 49 55 67 69 70 81 82 84 87 112 117 118 7-20,8074 7 19 21 22 35 37 38 49 50 52 55 67 69 84 87 100 103 105 112	7-20.8	7 19		22		က	49	52	67					97	86	100	111	112	115	
7-20.8070 7 19 21 22 35 37 38 49 50 67 69 70 81 82 87 97 100 111 112 7-20.8071 7 19 21 22 35 37 38 49 50 67 69 70 81 82 84 87 97 111 112 7-20.8072 7 19 21 22 35 37 38 49 50 67 69 70 81 82 84 87 97 111 112 7-20.8073 7 19 21 22 35 37 38 49 50 57 69 70 81 82 84 87 97 101 111 177-20.8073 7 19 21 22 35 37 38 49 50 52 67 69 70 81 82 84 87 97 111 112 7-20.8074 7 19 21 22 35 37 38 49 55 67 69 70 81 82 84 87 112 117 118 7-20.8075 7 19 21 22 35 37 38 49 50 52 55 67 69 84 87 100 103 105 112	7-20.8	7 19		22			49	20	52					87	97	98	111	112	115	
-20.8071 7 19 21 22 35 37 38 49 50 67 69 70 81 82 84 87 97 111 112 20.8072 7 19 21 22 35 37 38 49 50 67 69 70 81 82 84 87 97 101 112 20.8073 7 19 21 22 35 37 38 49 50 52 67 69 70 81 82 84 87 97 100 111 20.8074 7 19 21 22 35 37 38 49 55 67 69 70 81 82 84 87 112 117 118 20.8074 7 19 21 22 35 37 38 49 55 67 69 70 81 82 84 87 112 117 118 20.8075 7 19 21 22 35 37 38 49 50 52 55 67 69 84 87 100 103 105 112	7-20.8	7 19		22			49	20	67					87	97	100	111	112	115	
-20.8072 7 19 21 22 35 37 38 49 50 67 69 70 81 82 84 87 97 100 111 -20.8073 7 19 21 22 35 37 38 49 50 52 67 69 70 81 82 84 87 97 111 -20.8074 7 19 21 22 35 37 38 49 55 67 69 70 81 82 84 87 17 118 -20.8075 7 19 21 22 35 37 38 49 50 52 55 67 69 84 87 100 103 105 112	7-20.8	7 19		22			49	20	29				82	84	87	97	111	112	117	
-20,8073 7 19 21 22 35 37 38 49 50 52 67 69 70 81 82 84 87 97 111 1 -20,8074 7 19 21 22 35 37 38 49 55 67 69 70 81 82 84 87 112 117 118 1 -20,8075 7 19 21 22 35 37 38 49 50 52 55 67 69 84 87 100 103 105 112 1	7-20.8	7 19		22		m	49	20	67				82	84	87	97	100	111	112	
-20,8074 7 19 21 22 35 37 38 49 55 67 69 70 81 82 84 87 112 117 118 1 -20,8075 7 19 21 22 35 37 38 49 50 52 55 67 69 84 87 100 103 105 112 1	7-20.8	7 19		22		m	49	20	52				81	82	84	87	97	111	112	
0.8075 7 19 21 22 35 37 38 49 50 52 55 67 69 84 87 100 103 105 112 1	-20.8	7 19		22		m	49	55	67				82	84	87	112	117	118	123	
	-20 F	7 19		22		m	49	20	52				84	87	100	103	105	112	115	
	•			1		)	1	,												

k = 28, Designs sorted based on word length pattern

CD2 rank	1	2	က	4	ß	60	10	11	18	16	16	20	21	22	24	24	24	27	28
CD2*	7.0617	7.0751	7.0784	7.0806	7.0827	7.0840	7.0840	7.0842	7.0848	7.0848	7.0848	7.0849	7.0849	7.0850	7.0850	7.0850	7.0850	7.0852	7.0856
Lmax rank	1	2	194	195	196	1200	1201	1202	2300	1203	1203	1205	1206	1207	2301	1208	1208	1210	2302
C2FI rank	3930	3931	3932	3933	3934	3935	3936	3937	3938	3938	3938	3941	3942	3943	3944	3944	3944	2855	3947
df rank	2	m	60	10	11	3649	3650	3651	3652	3652	3652	3655	3656	3657	3658	3658	3658	4	3661
Гтах	g e	7	σ	6	D	10	10	10	11	10	_		10			10	10	10	11
C2FI Lmax	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0
df o	126	126	124	124	124	115	115	115	115	115	115	115	115	115	115	115	115	126	115
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	-	0	0	0	0	0	Н	0	0	0	7
	0	0	0	0	0	7	~	7	0	m	٣	٣	က	ო	0	٣	٣	m	Н
0	0	0	7	2	ო	S	ა	2	9	m	m	m	ო	ო	9	ო	က	0	4
alp	0	0	6	8	7	0	0	0	0	H	Н	Н	Н	Н	0	ч	~	0	Н
	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	28	13	7	Н	0	7	0	7	0	0	7	0	0	0	0	0	2	22	9
	0	0	15	22	56	œ	14	œ	16	16	10	16	13	91	91	91	2	81	0
	0	0	33	21	18	25	46	52	42	42	48	42	21	42	42	42		0	99
	6	55	ø	12	6	17	19	17	21	21	6	21	12	21 '	21 ,	21 4	19	34	11
	0	15	30	30	33	Н	Н	Н	-	Н	Н	Н	4	Η.	-	Н	 H	m	-
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0
wlp rank	1	2	ო	4	S	9	7	œ	σ	6	6	12	13	14	15	15	12	18	19
î	2800	752	2976	928	940	2960	2959	2960	949	949	949	2948	2948	950	949	2949	2949	3232	2940
× ×	1			710 2															
wlp (w4,)	840	780	717	•	703					674			675			676		648	672
	210	230	238	241	244	248	248	248	249	249	249	249	249	249	249	249	249	250	250
Design	28-21.1	28-21.2	28-21.3	28-21.4	28-21.5	28-21.6	28-21.7	28-21.8	28-21.9a	28-21.9b	28-21.9c	28-21.12	28-21.13	28-21.14	28-21.15a	28-21.15b	28-21.15c	28-21.18	28-21.19

k=28, Designs sorted based on degrees of freedom used

	wlp (w4,)	wlp							alp	Q.						df	CZFI	C2FI Lmax	qţ	C2FI		CD2*	CD2
		rank																	rank	rank	rank		rank
28-21.1157 290 53	290 536 3320 1157	1157	24 1	2	0	48	0			12	P	2	0	0	0	127	24	11	-	2830	2771	7,1145	2583
	0 2800	1	0		70	0	0	6	0	0	0	0	0	0	0	126	0	9	2	3930		7.0617	٢
	0 2752	7	0	15 5	ທ	0	0	3 15	0	0	0	0	0	0	0	126	0	7	က	3931		7.0751	2
	8 3232	18	18	3	7	0	18 23	2	0	0	٣	0	0	0	0	126	18	10	4	2855	1210	7.0852	27
	4 3192	28	18	S S	7	9	12 1	9	0	0	٣	0	0	0	0	126	18	10	S	2856		7.0885	73
	8 3208	172	18	9		0	6	0 12	٥.	0	ო	0	0	0	0	126	18	10	9	2857		7.0919	175
	4 3656	2961	27	6 3	34	0		7	9	0	9	0	0	0	0	126	27	10	7	2398		7.1290	3555
	6 3680	3388	27			0	0	S	0	σ.	9	0	0	0	0	126	27	10	80	2602		7.1334	3705
	7 2976	က	0	30	9	3 1	.,		9	-	0	0	0	0	0	124	0	Ð	9	3932		7.0784	m
28-21.4 241 71(	0 2958	4	0			1 2	2 1	1 0	8	2	0	0	0	0	0	124	0	σ	10	3933		7.0806	4

k=28, Designs sorted based on the number of clear two-factor interactions

wlp (w4,)	٧4 ,)	wlp rank							alp	•						df	CZFI	I Lmax	ax df rank	C2FI c rank	Lmax c rank	CD2*	CD2 rank
515 90	7062	4280	53	0	0	0	0	0		0	16	15	0	0	0	112	53	11	423	-	3461	(	4280
515 90		4281	53	0	0	0	0	0	0	0	16	15	0	0	0	112	53	11	4232	2	3462	7,3351	4281
516 89		4282	53	0	0	0	0	0	0	0	19	0	က	0	0	112	53	12	423	3	4084	•	4282
516 90	7052	4283	53	0	0	0	0	0	0	0	19	O	က	0	0	112	53	12	•	1 4	4085	•	4283
518 88		4284	53	0	0	0	0	0	0	0	24	0	9	Н	0	112	53	13	423	5	4264	•	4284
445 160	_	4268	37	20	0	0	0	0	0	0 10	20	1	0	0	0	116	37	11	364	9	3456		4268
445 160	_	4269	37	20	0	0	0	0	0	0 10	20	-	0	0	0	116	37	11	364	7	3457	•	4269
446 159	•	4270	37	20	0	0	0	0	0	0 13	14	4	0	0	0	116	37	11	364	9	3458	7	4270
446 160	0 5820	4271	37	20	0	0	0	0	0	0 13	1 14	4	0	0	0	116	37	11	364	g 0	3455	7.2572	4271

k=28, Designs sorted based on minimizing Lmax

Design	wlp(w4,)	(")	wlp rank							alp							df C	ZFI ]	df C2FI Lmax	df rank	C2FI rank	Lmax rank	CD2*	CD2 rank
28-21.1	210 840	2800	1	0	0	70	0	0 28	0	0	0	0	0	0	0	0	126	0	9	2	3930	1	7.0617	1
28-21.2	230 780	2752	7	0	15	55	0	0 13	15	0	0	0	0	0	0	0	126	0	7	ო	3931	7	7.0751	7
28-21.681	280 325	4653	681	27	0	0	5 2	1 26	5 10	0	0	0	0	0	0	0	117	27	7	787	876	ო	7.0927	213
28-21,732	282 323	4637	732	27	0	0	7 2	1 20		0	0	0	0	0	0	0	117	27	7	789	877	4	7.0944	275
28-21,795	284 321	4621	795	27	0	0	11 1	15 20	) 16	0	0	0	0	0	0	0	117	27	7	197	883	S	7.0960	343
28-21.733	282 323	4640	733	27	0	0	6 2	21 26		က	0	0	0	0	0	0	117	27	œ	190	878	9	7.0944	276
28-21.772	283 322	4630	772	27	0	Н	4 2	24 22		m	0	0	0	0	0	0	117	27	80	794	880	7	7.0952	307
28-21.773	283 322	4631	773	27	0	0	7 2	1 23	8	n	0	0	0	0	0	0	117	27	œ	795	881	ထ	7.0952	308
28-21,794	284 321	4621	794	27	0	$\vdash$	6 2	2 15	3 12	7	0	0	0	0	0	0	117	27	œ	196	882	თ	7.0960	343
28-21,796	284 321 4621	4621	962	27	0	7	4 2	1 24	80	က	0	0	0	0	0	0	117	27	œ	798	884	10	7.0960	343

k = 28, Design generators

1000											ľ		l	-1								
Design						- 1			1	- 1	esi	gu	ner	입	2							
8-21	7	11	19	30	38	47	ď	7	ထ				œ			7	٠.,	Н	19 1	0	126	
28-21,2	7	11	19	30	38			_	80				80			6			8 1	σ	120	
28-21.3	7	11	19	29	37	38	_	44 5	0				œ	9 92	9	7	•	109 1	8	20 1	123	
28-21.4	7	11	19	29	37	Н		0	2				80			_			9		125	
28-21.5	7	11	13	14	19	Н		S	S				7			_	-		0		125	
28-21.6	7	11	13	14	13		22	38 4					7			m		101	മ		120	
8-2	7	11	19	29	30	2		52 5					00			7			œ		123	
_:	7	11	13	14	13	• •	22	38 4								m		101	m		120	
9.	7	11	13	13	22	•	8	38 4	1 4										m		126	
5	7	11	19	29	30	5		41 5		60 7	77 78		68 9			5 97	7 11(	10	119 1	120 1	126	
-21.9	7	11	19	29	30	8	41 4	42 4										m	~		120	
	7	11	13	29	30	-		53 5							_				0		125	
21.1	7	11	13	59	35	45 4	46.5	53 5	4										0		126	
21.1	7	11	19	59	38		42 4	9 6	0										98 1		125	
28-21.15a	7	11	13	13	22		28 3	38 4	-										8		126	
1.1	7	11	19	29	30	S	-	41 4	6										0		26	
21.1	7	11	19	29	30		41 4	42 4	6									-	_		20	
1.1	7	11	19	σ	30	æ	-	44 7	0						112				0		.27	
21,	7	11	13	4	19	21 2	22 3	38 4	-									٠.	6		56	
-21.	7	11	19		56	28	31 3	35 4	2								_	84 11	ω.	0	.25	
28-21.172	7	11	19	6	30		41.4	7	7							109	_	44	3	9	20	
28-21.681	7	11	21				41 5	52 5	6								•	N	-	.22	24	
-21.	7	11	13			35	37 4	41 5	2									-	_	2	24	
-21.	7	11	19	21		35 3	37 4	1 5	2									^,		~	24	
-21.	7	11	19	$\vdash$		28 3		S	2	9 62	2 73						_	٠.		N	24	
28-21.773	7	11	21	2		31 3	35.4	45 5	2									-		N	24	
	7	11	21	56		41 4	•	2	0			7 84	1 91	104	107	112		7 121		122 1	124	
-21.7	7	11	19	_		28 4		4									7		_	N	24	
-21.7	7	11	19			28 3		4	1 5								_			22 1	24	
1,1	7	11	13			38 5	2 6	60 7	e e	5 95	5 101					٠.	_	_	~	25 1	56	
-21.296	7	11	13			22 3		m	7									Н	9 11	19 1	20	
-21.33	7	11	13			25 2	6 4	9	4				103			٠.		5 12	11 12	2 1	24	
-21.42	7		21			37 3	8	9	0									Н	12 11	17 1	118	
1.42	7	19	21	2		37 3	8 4	9	0			_	81	84		4-1		1 11	12 11	5	118	
-21.427	7			7		37 3	8 4	9	0			_		81				1 11	2 1	5	118	
28-21.4271	7					37 3	8 4	1 4	6	2 67	7 69	9 70		84				-1	7 11	18 1	23	
1.428	7	19			35	37 3		9 5(	0			_		87	97	6		Н	1 11	2	15	
28-21,4281	7			2	35	37 3		ഗ				_	82	84		6		٠.	Н	~	18	
1.428	7	19	21	2	35	37 3	8	9 5		_		3 70	81	82		80			Ч		12	
-21.4	7	19	21	22	35	37 3	8	S	0	52 67	7 69	07 6	81	82	84	87	7 97	٠.	111 11	12 1	118	
28-21,4284	7	19	21	7	35	37 3		9 50		٠,	5 67	69	70	81	82	8			7 11	11 1	12	
																				l		

k = 29, Designs sorted based on word length pattern

	1 1 1	2	תומ	df C2FI Lmax df	f C2FI	Lmax	CD2*	CD2
Design	WIP ( W41)	rank	<i>b</i> 1 = 5	H				rank
		-	0 0 0 0 0 0 0 0 0 0 0 0 0 0	127 0 7	1 1914		6.4312	-1
29-22.1	7 0		30 21 6	125 0 9	4 1915		6.4414	7
29-22.2	823			0 10	•		6.4415	ന
29-22.3	810						6.4423	Ŋ
29-22.4	810	ਰਾ।		116 0 11 179			6.4423	ဖ
29-22.5	810			0			6.4432	14
29-22.6	816		9 0	116 0 11 176			6.4430	თ
29-22.7a	808	- 1	0 0 10 46 22 2 0 0 2 3 2 0 0 0	1 -			6.4430	σ
29-22.7b	808	7	0 0 8 52 Te 4 0 0 2 3 2 0 0 0	11.			6.4431	11
29-22.9a	810	on (	0 0 10 46 22 2 0 0 2 3 2 0 0 0	1 -			6.4431	11
29-22.9b	810	ָר פ		11			6.4431	13
29-22.11	810		0 0 17 40 28 0 0 0 2 3 7 0 0 0				6.4433	15
29-22.12a	812						6,4433	15
29-22.12b	812		0 0 8 32 16 4 0 0 2 3 2 0 0	12			6.4438	19
29-22.14a	808		0 0 8 34 12 6 0 0 2 4 0 1 0 0	0 12			6.4438	18
29-22.14b	292 808 3/14	4 4	0 0 12 42 24 2 0 0 2 4 0 1 0 0	116 0 12 1804	04 1929	1267	6.4439	20
29-22.16a	8 TO		0 0 12 42 24 2 0 0 2 4 0 1 0 0	0 11			6.4439	20
29-22.165	810	0 0	0 0 17 36 30 0 0 3 1 3 0 0 0	0 11			6.4440	22
29-22.18	STO	0 7		0 12			6.4441	23
29-22.19	812	19						

k=29, Designs sorted based on degrees of freedom used

CD2 rank	1 121 1878 2 2 14 180 163 191 205 267
CD2*	6.4312 6.4515 6.4544 6.4432 6.4544 6.4550 6.4550
Lmax rank	1 834 1146 20 262 265 843 850 851
C2FI rank	1914 1407 1400 1915 1919 1661 1473 1474
df rank	10.64.60.00.00.00.00.00.00.00.00.00.00.00.00.
C2FI Lmax	7 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2FI	0 118 27 27 0 0 0 12 12 14
df 0	127 127 127 125 125 125 125 125 125
	000000000
	000000000
	000000001
	0 m w 0 0 0 0 m m r r
	000040000
	0 0 6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
alp	0000000000
	110000000000000000000000000000000000000
	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
	0 0 0 18 0 0 0 30 21 18 27 24 23 3 24 23 7 16 7 16
	70 0 37 0 40 0 0 30 6 18 4 24 18 3 18 7 20 11
	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
	118 27 27 12 12 14
wlp rank	114 1725 2 2 6 147 152 181 182 224
·	945 3472 729 4096 537 4736 823 3819 816 3798 740 3963 712 4156 704 4148 710 4132
W4,	00 C 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
wlp (w4,)	266 94 306 72 370 53 287 82 290 81 309 74 310 71 312 70 315 70
E	29-22.11 29-22.114 29-22.1725 29-22.2 29-22.147 29-22.182 29-22.181 29-22.182
Design	29-22.11 29-22.11 29-22.17 29-22.2 29-22.14 29-22.14 29-22.15 29-22.18

k=29, Designs sorted based on the number of clear two-factor interactions

29-22.2147         605 101 9075         2147         55 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Design	wlp (w4,)	(4.4)	wlp rank							alp	Ωι						df	1	C2FI Lmax	ax df rank	C2FI c rank		Lmax rank	CD2*	CD2 rank
606 100 9064 2148 55 0 0 0 0 0 0 0 0 0 24 4 3 0 115 55 606 101 9064 2149 55 0 0 0 0 0 0 0 0 0 24 4 3 0 115 55 526 180 7522 2140 36 22 0 0 0 0 0 0 0 16 14 1 0 0 118 36 52 17 77 7513 2142 36 22 0 0 0 0 0 0 0 16 14 1 0 0 118 36 52 17 77 7513 2142 36 22 0 0 0 0 0 0 0 16 14 1 0 0 118 36 52 17 17 7513 2142 36 22 0 0 0 0 0 0 0 19 8 4 0 0 118 36 54 180 7512 2143 36 22 0 0 0 0 0 0 0 19 8 4 0 0 118 36 38 32 5626 1912 35 0 0 0 6 31 11 0 0 0 6 1 0 0 19 35 38 31 5615 1917 35 0 0 0 16 12 20 0 0 0 5 2 0 0 119 35 38 317 5619 1936 35 0 0 0 16 12 20 0 0 0 5 2 0 0 119 35		605 101	9075		55	0	0	0	0	0	0	0	0	0 2	1 10		0	115	55	12	2112	2,	18		6.7120	2147
606 101 9064 2149 55 0 0 0 0 0 0 0 0 0 24 4 3 0 115 55 526 180 7522 2140 36 22 0 0 0 0 0 0 0 16 14 1 0 0 118 36 52 6 180 7524 2141 36 22 0 0 0 0 0 0 0 16 14 1 0 0 118 36 52 177 7513 2142 36 22 0 0 0 0 0 0 0 19 8 4 0 0 118 36 52 1 179 7512 2143 36 22 0 0 0 0 0 0 0 19 8 4 0 0 118 36 38 322 5626 1912 35 0 0 0 6 31 11 0 0 0 6 1 0 0 19 35 38 321 5615 1917 35 0 0 0 6 31 11 0 0 0 6 1 0 0 19 35 38 317 5619 1936 35 0 0 0 16 12 20 0 0 5 2 0 0 119 35		606 100	9064		52	0	0	0	0	0	0	0	0	0 2	4	6	0	115	55	13	2113	.,	2 20	2093	6.7127	2148
526 180 7522 2140 36 22 0 0 0 0 0 0 16 14 1 0 0 118 36 52 180 7524 2141 36 22 0 0 0 0 0 0 0 16 14 1 0 0 118 36 52 180 7524 2141 36 22 0 0 0 0 0 0 0 16 14 1 0 0 118 36 52 1179 7513 2142 36 22 0 0 0 0 0 0 0 19 8 4 0 0 118 36 38 327 180 7512 2143 36 22 0 0 0 0 0 0 0 19 8 4 0 0 118 36 38 38 322 5626 1912 35 0 0 0 6 31 11 0 0 0 6 1 0 0 19 35 38 321 5615 1917 35 0 0 0 16 28 11 1 0 0 6 5 2 0 0 119 35 38 317 5619 1936 35 0 0 0 16 12 20 0 0 5 2 0 0 119 35		606 101	9064		52	0	0	0	0	0	0	0	0	0 2	4		0	115	55	13	211	٠٠,	3 20		6,7128	2149
526 180 7524 2141 36 22 0 0 0 0 0 0 16 14 1 0 0 118 36 52 179 7513 2142 36 22 0 0 0 0 0 0 0 19 8 4 0 0 118 36 52 180 7512 2143 36 22 0 0 0 0 0 0 0 19 8 4 0 0 118 36 34 322 5626 1912 35 0 0 0 6 31 11 0 0 0 6 1 0 0 19 8 35 385 321 5615 1917 35 0 0 0 8 28 11 1 0 0 6 1 0 0 119 35 389 317 5619 1936 35 0 0 0 16 12 20 0 0 5 2 0 0 119 35		526 180	7522		36	22	0	0	0	0	0	0	0	6 1.	-	0	0	118		12	178	7	1 18		6.6300	2140
527 179 7513 2142 36 22 0 0 0 0 0 0 19 8 4 0 0 118 36 527 180 7512 2143 36 22 0 0 0 0 0 0 0 19 8 4 0 0 118 36 384 322 5626 1912 35 0 0 6 31 11 0 0 6 1 0 0 119 35 385 321 5615 1917 35 0 0 0 8 28 11 1 0 0 6 1 0 0 119 35 389 317 5619 1936 35 0 0 0 16 12 20 0 0 5 2 0 0 119 35		526 180	7524		36	22	0	0	0	0	0	0	0	6 1,	1	0	0	118		12	178.	~	5 18		6.6301	2141
527 180 7512 2143 36 22 0 0 0 0 0 0 19 8 4 0 0 118 36 384 322 5626 1912 35 0 0 0 631 11 0 0 0 6 1 0 0 119 35 385 321 5615 1917 35 0 0 0 8 28 11 1 0 0 6 1 0 0 119 35 389 317 5619 1936 35 0 0 0 16 12 20 0 0 5 2 0 0 119 35		527 179	7513		36	22	0	0	0	0	0	0	0	6	3	0	0	118		12	178	_	5 18		6.6308	2142
384 322 5626 1912 35 0 0 0 6 31 11 0 0 0 6 1 0 0 119 35 385 321 5615 1917 35 0 0 0 8 28 11 1 0 0 6 1 0 0 119 35 389 317 5619 1936 35 0 0 0 16 12 20 0 0 0 5 2 0 0 119 35		527 180	7512		36	22	0	0	0	0	0	0	0	6	3 4	0	0	118		12	1785	.~	7 18		6.6309	2143
385 321 5615 1917 35 0 0 0 8 28 11 1 0 0 6 1 0 0 119 389 317 5619 1936 35 0 0 0 16 12 20 0 0 0 5 2 0 0 119		384 322	5626		35	0	0	0	9	31 1		0	0	0	5	0	0	119			1525	ω,	3 17		6.4940	1853
389 317 5619 1936 35 0 0 0 16 12 20 0 0 5 2 0 0 119		385 321	5615		32	0	0	0	00	28 1			0	0	5 1	0	0	119		12	1526	J.	17		6.4947	1860
		389 317	5619		35	0	0	0	16	12 2	0.	0	0	0	12	0	0	119	.,	12	1538	3 10	_		6.4980	1899

k = 29, Designs sorted based on minimizing Lmax

Design	wlp (w4,)	(/1	wlp							a	alp						d£ (	CZFI	Lmax		CZFI	Lmax	CD2*	CD2
			rank																	rank	rank	rank		rank
29-22.1	266 945	3472		0	0	70	0	0		0	0	0	0	0	0	0	127	0	7	-	1914	1	6.4312	1
29-22.379	330 376	5894		28	0	0	3.1	0 3	32 12	5	0	0	0	0	0	0	119	28	80	373	333	2	6.4526	136
29-22.390	331 375	5885		28	0	0	2 1	18 17	7 22	ω.	0	0	0	0	0	0	119	28	00	374	334	٣	6.4533	144
29-22.405	332 374	5876		28	0	0	4 1	13 23		5	0	0	0	0	0	0	119	28	œ	376	336	4	6.4540	164
29-22.424	333 373	5871		28	0	0	3.1	17 20		7	0	0	0	0	0	0	119	28	80	378	338	S	6.4548	184
29-22.432b	334 372 5856	5856	432	28	0	0	5 1	12 26	6 10	9	0	0	0	0	0	0	119	28	80	379	340	9	6.4555	206
29-22.434b	334 372	5862		28	0	0	5 1			7	0	0	0	0	0	0	119	28	80	381	342	7	6.4555	208

k = 29, Design generators

29-22 1												-											
7.77_C7	7	1	13	0		47		_			70	73	79	82			97	86	108		9 120	٠.	126
29-22.2	7	11	19	59	35	37	38 5		63	69	70	73	19	81	87	97				1117		٠.	er.
29-22.3	7	11	19	0		35 '		N			69	73	74	81			100					٠.	<u>د</u>
29-22.4	7	11	13	9		41,	42 4	ത			17	18	82	86								٠.	ις.
29-22.5	7	11	19	6		35 '	-				73	79	82	86	•	_	Н	115				٠.	7:
	7	11	19	σ		41 '	44 5	50 5			62	73	9/	82				_				٠.	ις.
ö	7	11	19	o		35	41 4	14 4			26	67	11	78								٠.	4
29-22.7b	7	11	13	4		28	35 4	14 5			28	29	9/	82			٠.						9
2	7	11	13	6	30	35 '	45 4	16 4			26	73	79	82	٠.	-	٠.						7
9-2	7	11	19	6	30	35	44 5	52 5			67	69	73	74			٠.					٠.	e:
ς,	7	11	13	-	22	25	26	35 4			49	09	67	77									83
9-2	7	11	19	6	35	45	53	4	_		69	70	81	82								٠.	2
	7	11	19	6	30	32	45	54 5	57		29	69	70	73									52
ς.	7	11	19	6	30	35	41 4	47 5			17	82	84	88	٠.	-							7:
ď	7	11	13	6	30	35	41	14 4		53	54	56	67	78									24
29-22.16a	7	11	19	6	30	35	45 4	49 5			73	19	85	88	٠.	-							7.
9-22.1	7	11	19	0	35		41 4	42 4	49		29	11	78	85									0.7
2.1	7	11	19	σ	35		53	4			69	70	73	81									33
29-22.19	7	11	19	30	35			53 5	4	29	11	82	84	88		4							7.
29-22.114	7	11	13	19	21		-,	57 6	09	29	69	70	73	16									50
2.1	7	11	19	29	35	37	38	57 6	63		69	70	73	79	8		86		3 109				23
2.1	7	11	13	19	25			38 4			52	29	69	73									33
2.18	7	11	13	21	25	31		41 5	1	61	18	98	88	97		٠.							24
29-22.182	7	11	13	21	25			-	41		61	18	98	88									24
2.22	7	11	13	14	19			38	1.		67	69	70	74									50
ď	7	11	19	21	56		35	37 4	11		29	62	73	79									24
29-22.390	7	14	19	22	31	32	38	41 4	2		29	62	70	77									24
ď	7	11	25	31	37	38	41	47	11		62	9/	82	93		• •							24
	7	11	19	21	56	28	Z.	41 5	25		29	62	73	79									24
2.4	7	11	13	21	22	44	55	62 7	73	74	97	19	83	93	97								24
-22.4	7	11	25	31	37	38		47	5.1		16	82	87	93	98	٠.		_					24
_	7	11	29	37	41	42	44	47	11		81	82	84	87				-	$\vdash$				27
Н	7	11	19	30	35	41	42,	-	17	26	29	29	81	87		104	٠.	117	7 12:	_			27
2.1	7	터	19	29	35	38	41	42 4	14		26	67	87	88			٠.	-	~	_			27
22.193	7	11	19	30	35	41	-		47		29	74	81	82			٠.	-		_			27
29-22.2140	7	19	21	22	35	37	38	49	20	52	56	67	69	70	81		84			_	П	2	18
22.21	7	19	21	22	35	37	-		20		29	69	70	81			: :	Н	-	٥,	5 11	7	18
-22.	7	19	21	22	35	37	38		20		22	26	67	69					-		7	Ŋ	18
29-22.2143	7	19	21	22	35	37	38		27		70	81	82	84						Н	Н	0	15
22.214	7	19	21	22		37	38		0.0		67	69	70	81				1 97	7 98	П	00 11	_	12
-22.	7	19	21	22	35	37	38	49	00		55	67	69	70							8 11	1	12
	1	0	5	cc		7	000	0 7	0		L	Ç		1						۲	•		0

k = 30, Designs sorted based on word length pattern

Design	wlp (w4,)	<u> </u>	wlp							B	alp							df c	CZFI	Lmax	d£	CZFI	Lmax	CD2*	CD2
			rank																		rank	rank	rank		rank
30-23.1	972	4662	1	0	6	0	0.4	0		0	0	2	S	0	0	0	0	117	0	11	773	799	182	5.8661	-
30-23.2	972	4650	2	0	0	0	12 3	9	2	0	0	က	က	٦	0	0	0	117	0	12	774	800	379	5.8668	2
30-23.3	336 972 4	1651	٣	0	0	0	12 3	9	2	0	0	m	m	1	0	0	0	117	0	12	775	801	380	5.8668	m
30-23.4	972	4652	4	0	0	0	12 3	9	~	0	0	m	٣	П	0	0	0	117	0	12	176	802	381	5.8668	4
30-23.5	968	1644	ഹ	0	0	0	14 3	2	4	0	0	4	Н	7	0	0	0	117	0	12	777	803	382	5.8673	9
30-23.6	972	1640	9	0	0	0	14 3	2	~	0	0	4	٦	7	0	0	0	117	0	12	778	804	383	5.8675	7
30-23.7	916	644	7	0	0	0	14 3	2	Ψ.	0	0	4	-1	7	0	0	0	117	0	12	779	805	384	5.8679	6
30-23.8	968	4633	<b>o</b> o	0	0	0	16 2	@	s S	0	0	4	7	0	٦	0	0	117	0	13	780	908	586	5.8680	10
30-23.9	972	4630	6	0	0	0 4	6 2	00	9	0	0	4	7	0	-	0	0	117	0	13	781	807	587	5.8683	11
30-23.10	916	633	10	0	0	0	6 2	œ	S	0	0	4	7	0	Н	0	0	117	0	13	782	808	588	5.8686	13
30-23.11	968	620	11	0	0	0	48 2	4	ص ص	0	0	ഗ	0	-	Н	0	0	117	0	13	783	809	589	5.8687	14
30-23.12	916	620	12	0	0	0	48 2	4	9	0	0	Ŋ	0	Н	Н	0	0	117	0	13	784	810	590	5.8693	16
30-23.13	945	723	13	0	0	9	5 3	m	S	0	0	-	9	0	0	0	0	117	0	11	785	811	183	5,8691	15
30-23.14	968	009	14	0	0	0 5	2 1	9	21	0	0	S	٦	0	0	-1	0	117	0	14	186	812	863	5.8701	24
30-23.15	916	009	15	0	0	0	2 1	6 1.	0	0	0	S	-	0	0	⊣	0	117	0	14	787	813	864	5.8708	28
30-23.16	944	712	16	0	0	9	7 2	<u>۔</u> ص	~	0	0	7	4	٦	0	0	0	117	0	12	788	814	385	5.8697	19
30-23.17	944	712	17	0	0	8	1 3	'n	ic O	0	0	7	4	H	0	0	0	117	0	12	789	815	386	5.8697	20
30-23.18	945	711	18	0	0	8	3	S	0	0	0	7	4	Н	0	0	0	117	0	12	190	816	387	5.8698	21
30-23.19	946	712	19	0	0	8	3	2	0	0	0	7	4	Н	0	0	0	117	0	12	791	817	388	5.8699	22
30-23.20	946	712	20	0	0	6 3	7 2	ص ص	°	0	0	7	4	Н	0	0	0	117	0	12	792	818	389	5.8699	22

 $k\,=\,30$ , Designs sorted based on degrees of freedom used

30-23.30         345 935 4855         30         0 15 36         0 5         0 10         0 0         0 126         0 10         1         828           30-23.156         370 840 5068         156         8 22         0 18 33         0 5         0 4         6 0 0         0 126         12         12         12         12         12         12         12         13         12         1         0 5         0 4         6 0 0         0 126         12         12         3         585           30-23.161         371 806 5286         161         12 12 21         3 12 21         3 0 9         0 0 0         126         12         12         3 585           30-23.126         368 840 5131         126         8 6 24 25         0 24 0 1 0 6         0 0 0 124         8 11         5 627           30-23.134         367 836 5172         134         8 6 24 25         0 3 18         3 1 0 6 0 0 0 124         8 11         6 630           30-23.135         369 828 5192         145         8 6 24 25         0 7 11 6 0 1 6 0 0 0 124         8 11         7 631	Design	wlp (w4,)	wlp rank	alp	df	C2FI Lmax	x df rank	C2FI rank	Lmax rank	CD2*	CD2 rank
370 840 5068 156 8 22 0 18 33 0 0 5 0 4 6 0 0 0 126 8 11 2 2 371 806 5286 161 12 12 21 3 12 21 3 0 9 0 0 3 0 0 126 12 12 12 12 3 387 758 5398 239 14 10 24 0 17 16 0 3 2 7 0 3 0 0 0 126 12 12 3 36 840 5181 126 8 6 24 25 0 0 24 0 1 0 6 0 0 0 124 8 11 5 36 86 815 5170 134 8 6 24 25 0 3 18 3 1 0 6 0 0 0 0 124 8 11 6 367 838 5170 135 8 6 24 25 0 3 18 3 1 0 6 0 0 0 0 124 8 11 6 369 818 5192 145 8 6 24 25 0 7 11 6 0 1 6 0 0 0 0 124 8 11 8	30-23.30	345 935 4855		0 30 0 15 36 0	0 126	1	-	828	31	5.8722	
371 806 5286 161 12 12 21 3 12 21 3 0 9 0 0 3 0 0 126 12 12 3 387 758 5398 239 14 10 24 0 17 16 0 3 2 7 0 3 0 0 0 126 14 12 4 366 840 5181 126 8 6 24 25 0 0 24 0 1 0 6 0 0 0 0 124 8 11 5 367 836 5172 134 8 6 24 25 0 3 18 3 1 0 6 0 0 0 0 124 8 11 6 367 838 5170 135 8 6 24 25 0 3 18 3 1 0 6 0 0 0 0 124 8 11 6 369 828 5192 145 8 6 24 25 0 7 11 6 0 1 6 0 0 0 0 124 8 11 8	30-23.156	370 840 5068		8 22 0 18 33 0	0 126		2	635	188	5.8858	231
387 758 5398 239 14 10 24 0 17 16 0 3 2 7 0 3 0 0 0 126 14 12 4 366 840 5181 126 8 6 24 25 0 0 24 0 1 0 6 0 0 0 0 124 8 11 5 367 836 5172 134 8 6 24 25 0 3 18 3 1 0 6 0 0 0 124 8 11 6 367 838 5170 135 8 6 24 25 0 3 18 3 1 0 6 0 0 0 124 8 11 7 369 828 5192 145 8 6 24 25 0 7 11 6 0 1 6 0 0 0 0 124 8 11 8	30-23.161	371 806 5286		12 12 21 3 12	0 126		m	585	440	5.8851	
366 840 5181 126 8 6 24 25 0 0 24 0 1 0 6 0 0 0 0 124 8 11 5 367 836 5172 134 8 6 24 25 0 3 18 3 1 0 6 0 0 0 124 8 11 6 367 838 5170 135 8 6 24 25 0 3 18 3 1 0 6 0 0 0 124 8 11 7 369 828 5192 145 8 6 24 25 0 7 11 6 0 1 6 0 0 0 0 124 8 11 8	30-23.239	387 758 5398		14 10 24 0 17	0 126		4	572	454	5.8948	
367 836 5172 134 8 6 24 25 0 3 18 3 1 0 6 0 0 0 0 124 8 11 6 367 838 5170 135 8 6 24 25 0 3 18 3 1 0 6 0 0 0 124 8 11 7 369 828 5192 145 8 6 24 25 0 7 11 6 0 1 6 0 0 0 0 124 8 11 8	30-23.126	366 840 5181		8 6 24 25 0 0	0 124	8 11	Ŋ	627	184	5.8834	
367 838 5170 135 8 6 24 25 0 3 18 3 1 0 6 0 0 0 0 124 8 11 7 369 828 5192 145 8 6 24 25 0 7 11 6 0 1 6 0 0 0 0 124 8 11 8	30-23.134	367 836 5172		8 6 24 25 0 3	0 124	8 11	9	630	185	5.8838	
369 828 5192 145 8 6 24 25 0 7 11 6 0 1 6 0 0 0 0 124 8 11 8	30-23,135	367 838 5170		8 6 24 25 0 3	0 124		7	631	186	5.8840	
	30-23.145	369 828 5192		8 6 24 25 0 7	0 124	8 11	80	632	187	5.8849	

k=30, Designs sorted based on the number of clear two-factor interactions

rank 706 113 11548 975 707 112 11536 976	din di	df C2FI Lmax df	f C2FI	Lmax CD2*	CD2
706 113 11548 975 707 112 11536 976		rank	••		rank
707 112 11536 976	9	57 13	1 1		975
000000000000000000000000000000000000000	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	57 14	2 2		916
448 371 7098 REE	27 0 0 0 0 7 0	36 12	3		835
449 370 7086 867	0 0 0 0 24 21 3 0 0 0 7 0 0	121 36 12	644 4	559 5.9223	837
454 365 7096 880	0 0 0 6 16 20 6 0 0 6 1	121 36 13			820
466 353 7148 911 36 0	0 0 5 3 16 16 3	36 13	3 6		901
35 0	0 0 0 12 12 9 15 0 0	35 13	15 7		882

k = 30, Designs sorted based on minimizing Lmax

CD2 rank	119 88 96 107 119
CD2*	5.8807 5.8788 5.8794 5.8801 5.8807
Lmax rank	11 2 8 4 5 9
C2FI rank	129 125 126 128 129 133
df rank	146 141 141 145 146 151
C2FI Lmax	യതതതതത
CZFI	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
d£ 0	121 121 121 121 121 121
	000000
	000000
	000000
	00000
	000000
	000000
	0 8 4 4 8 8
alp	118 122 121 121
	26 26 118 21 119 116
	16 22 22 21 15 22 22 16
	15 16 13 5 22 26 9 21 18 12 15 21 6 22 19 15 16 16
	0 4 4 4 6 0
	00000
	00000
	229999
wlp rank	245 230 235 241 245 255
()	430 7378 433 7404 432 7396 431 7386 430 7378
wlp(w4,)	389 430 7378 386 433 7404 387 432 7396 388 431 7386 389 430 7378
Design	30-23.245c 30-23.230 30-23.235 30-23.241 30-23.245a 30-23.255

1																١	I	ı					I	l	
1,   7,   11,   9, 29, 20, 23, 54, 54, 64, 96, 66, 77, 78, 81, 91, 91, 108, 116, 120, 122, 123, 144, 147, 53, 54, 56, 77, 77, 88, 81, 81, 121, 115, 121, 122, 122, 123, 141, 19, 19, 19, 29, 30, 34, 44, 47, 53, 54, 56, 77, 77, 88, 81, 81, 102, 108, 116, 121, 122, 122, 123, 119, 19, 29, 30, 34, 44, 47, 55, 56, 67, 77, 78, 81, 88, 101, 102, 104, 107, 112, 112, 122, 124, 119, 19, 29, 30, 34, 54, 54, 57, 58, 60, 67, 69, 79, 71, 81, 81, 81, 81, 91, 91, 91, 91, 91, 91, 91, 92, 91, 93, 94, 95, 95, 95, 96, 96, 97, 98, 98, 99, 90, 90, 102, 104, 107, 112, 112, 122, 124, 119, 19, 29, 30, 34, 46, 56, 35, 56, 67, 77, 78, 88, 88, 102, 102, 104, 107, 112, 112, 122, 124, 119, 19, 29, 30, 34, 47, 53, 54, 59, 77, 82, 88, 81, 102, 102, 104, 107, 112, 112, 122, 124, 119, 119, 29, 30, 35, 41, 47, 53, 54, 59, 77, 82, 88, 81, 102, 102, 104, 107, 112, 112, 122, 124, 119, 119, 29, 30, 35, 41, 47, 53, 54, 59, 77, 82, 88, 81, 102, 104, 107, 112, 112, 122, 124, 119, 119, 29, 30, 35, 41, 47, 53, 54, 59, 78, 88, 81, 102, 104, 107, 112, 112, 112, 122, 124, 119, 119, 129, 30, 35, 41, 47, 53, 54, 56, 77, 78, 88, 81, 102, 104, 107, 112, 112, 112, 122, 124, 119, 119, 29, 30, 35, 41, 47, 53, 54, 56, 77, 78, 88, 81, 104, 107, 112, 112, 112, 112, 113, 141, 141, 141, 141, 141, 141, 141	Design											Des	E,	Gene	rato	rs									
7 11 19 29 30 35 45 46 49 52 56 77 77 88 19 10 112 115 121 122 123 14 14 17 53 54 56 67 77 78 81 10 19 12 12 12 12 12 12 12 12 12 12 12 12 12	30-23.1	7	11	13	21	22	25 2	. 92	35 4	2		6			77	18			101	108		120	-	126	
7 11 19 2 12 2 2 5 6 3 4 5 4 6 4 9 6 6 7 77 78 8 1 9 5 101 108 116 120 122 125 126 3 5 4 5 4 6 4 9 6 6 6 7 77 78 8 1 9 5 101 108 116 120 120 120 3 0 3 5 4 5 4 6 5 3 7 5 8 6 6 7 6 7 7 7 8 8 1 8 1 101 10 10 10 112 121 122 122 123 10 1 10 2 9 3 0 3 5 4 5 4 6 5 3 7 5 8 6 6 7 6 7 6 9 7 9 8 100 103 104 107 112 121 122 122 124 11 19 2 9 3 0 3 5 4 1 4 7 5 3 5 4 6 7 6 9 7 8 8 10 10 10 10 10 10 112 113 121 122 124 10 10 10 10 10 10 10 10 10 10 10 10 10	30-23.2	7	11	19		30	35 4	15	16 4	6		99			85	88 1	٠.		112	115		122	П	127	
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235         7 11 13 14 19 31 35 38 42 49 50 52 59 67 79 85 98 104 109 112 121 122           239         7 11 14 25 26 28 31 45 53 67 70 85 88 97 98 100 103 104 112 121 122 124           241         7 11 25 31 37 38 41 47 51 61 62 76 82 87 93 81 103 104 112 113 122 124           245         7 11 13 14 21 26 31 35 41 42 44 7 56 59 61 69 79 86 97 103 104 112 111 121 122 122           245         7 11 13 14 21 26 28 31 35 37 41 52 59 69 79 86 97 103 104 112 111 121 122 124           255         7 11 19 30 35 41 42 44 47 56 59 67 81 87 88 104 112 117 121 122 124           866         7 11 19 30 35 41 42 44 47 56 59 67 81 87 88 104 112 115 117 121 122 124           880         7 11 19 30 35 41 42 44 47 56 59 67 81 87 88 104 112 115 117 121 122 124           899         7 11 19 30 35 37 41 42 44 47 56 59 81 82 87 88 104 112 115 115 121 122 124           911         7 11 19 30 35 37 41 42 44 47 56 59 81 82 87 88 104 112 115 115 121 122 124           912         7 11 19 30 35 37 34 44 47 56 59 81 82 87 88 104 112 115 121 122 124           913         7 11 19 30 35 37 34 49 50 52 55 67 89 10 81 82 84 87 97 98 100 111           914         7 19 21 22 35 37 38 49 50 52 55 67 69 70 81 82 84 87 97 98 100 111		7 1	1 1	<u>ر</u>	14.2	21.2	6 3	1 3	5 3,	7 4	1 5				. 69	62						121	_	124	
239 7 11 14 25 26 28 31 45 53 67 70 85 88 97 98 100 103 104 112 121 122 124 245a 7 11 12 5 31 37 38 41 47 51 61 62 76 82 87 93 98 103 104 112 112 112 112 122 124 13 14 21 26 31 35 41 52 56 59 61 69 79 86 97 103 104 112 112 112 112 122 124 13 14 21 26 83 135 37 41 42 44 50 59 62 70 77 87 98 104 112 117 121 122 124 86 7 11 19 30 35 41 42 44 47 56 59 67 81 87 88 104 112 117 121 122 124 86 7 11 19 30 35 41 42 44 47 56 59 67 81 87 88 104 112 117 121 122 124 880 7 11 19 30 35 41 42 44 47 56 59 67 81 87 88 104 112 115 117 121 122 124 889 7 111 19 30 35 41 42 44 47 56 59 67 81 82 87 88 104 112 115 121 122 124 899 7 11 19 30 35 37 41 42 44 47 56 69 81 82 87 88 104 112 115 115 121 122 124 91 11 119 30 35 37 48 49 50 52 55 67 69 70 81 82 87 88 104 112 115 121 122 124 91 11 11 11 11 11 11 11 11 11 11 11 11	30-23.235	7 1	1 1	ω <sub>.</sub>	14 1	193	1.3	5 3	8 42	2.4	9					6/				٠.		121	_	124	
241     7 11 25 31 37 38 41 47 51 61 62 76 82 87 93 98 103 104 112 118 121 122       245a     7 11 13 14 21 26 31 35 41 52 56 59 61 69 79 86 97 103 104 112 121 122       245c     7 14 19 22 31 35 38 41 42 44 50 59 62 70 77 87 98 104 112 117 121 122       255     7 11 19 30 35 41 42 44 47 56 59 67 81 87 88 104 112 117 121 122 124       866     7 11 19 30 35 41 42 44 47 56 59 67 81 87 88 104 112 115 117 121 122 124       887     7 11 19 30 35 41 42 44 47 56 59 67 81 87 88 104 112 115 121 122 124       899     7 11 19 30 35 37 41 42 44 47 56 67 81 82 87 88 104 112 115 121 122 124       911     7 11 19 30 35 37 41 42 44 47 56 67 81 82 87 88 104 112 115 121 122 124       912     7 12 12 35 37 38 49 50 52 55 67 69 70 81 82 84 87 97 98 100 111       913     7 19 21 22 35 37 38 49 50 52 55 67 69 70 81 82 84 87 97 98 101 112	30-23.239	7 1		4.	25.2	36.2	8	1 4	5 53	3	7 7				7.	98 1						122	_	127	
245a       7       11       13       14       21       26       31       35       41       52       56       59       61       69       79       86       97       103       104       112       121       122       122       122       13       38       41       42       44       50       59       62       70       77       87       98       104       112       117       121       122       122         866       7       71       19       30       35       41       42       44       75       59       67       81       87       88       104       112       117       121       122       124         880       7       11       19       30       35       41       42       44       75       69       81       82       88       104       112       112       122       124         880       7       11       19       30       35       41       42       44       47       56       59       69       81       82       88       104       112       112       121       121       121       121       121 <td< td=""><td>30-23.241</td><td>7 1</td><td>1.2</td><td>Š.</td><td>31.3</td><td>37 3</td><td>8 4</td><td>1 4</td><td>7 53</td><td>9</td><td>1 6</td><td></td><td></td><td></td><td>37</td><td>93</td><td>٠.</td><td></td><td></td><td>٠.</td><td></td><td>121</td><td></td><td>124</td><td></td></td<>	30-23.241	7 1	1.2	Š.	31.3	37 3	8 4	1 4	7 53	9	1 6				37	93	٠.			٠.		121		124	
245c       7 14 19 22 31 35 38 41 42 44 50 59 62 70 77 87 98 104 112 117 121 122         255       7 11 13 14 21 26 28 31 35 37 41 52 59 69 79 86 97 103 104 112 121 122         866       7 11 19 30 35 41 42 44 47 56 59 67 81 87 88 104 112 115 121 122 124         87       7 11 19 30 35 41 42 44 47 56 59 67 81 82 87 88 104 112 115 121 122 124         89       7 11 19 30 35 41 42 44 47 56 67 81 82 87 88 104 112 115 121 122 124         89       7 11 19 30 35 41 42 44 47 56 67 81 82 87 88 104 112 115 121 122 124         89       7 11 19 30 35 37 41 42 44 47 56 67 81 82 87 88 104 112 115 121 122 124         89       7 11 19 30 35 37 38 49 50 52 55 67 69 70 81 82 84 87 97 98 100 111         80       7 19 21 22 35 37 38 49 50 52 55 67 69 70 81 82 84 87 97 98 101 112	30-23.245a	7 1	11	ω -	4 2	21.2	9	1 3	5 41	.5	2 5				. 69	. 64				٠.		121	_	124	
255 7 11 13 14 21 26 28 31 35 37 41 52 59 69 79 86 97 103 104 112 121 122 124 866 7 11 19 30 35 41 42 44 47 56 59 67 81 87 88 104 112 117 121 122 124 867 7 11 19 30 35 41 42 44 47 56 59 67 81 87 88 104 112 115 117 121 122 124 889 7 11 19 30 35 41 42 44 47 56 59 69 81 82 87 88 104 112 115 121 122 124 899 7 11 19 30 35 37 41 42 44 47 56 67 81 82 87 88 104 112 115 121 122 124 911 7 11 19 30 35 37 41 42 44 7 56 67 81 82 87 88 104 112 115 121 122 124 911 7 11 19 30 35 37 38 49 50 52 55 67 69 70 81 82 84 87 97 98 100 111 97 976 7 19 21 22 35 37 38 49 50 52 55 67 69 70 81 82 84 87 97 98 110 112 112 112 112 112 112 112 112 112	30-23.245c	7 1	4.	o v	22.3	31 3	5 3	8 4	1 42	4.	4 5				0					٠.		121		124	
866       7       11       19       30       35       41       42       44       47       56       59       67       81       87       88       104       112       117       121       122       124         880       7       11       19       30       35       41       42       44       47       56       59       81       82       87       88       104       112       115       121       122       124         899       7       11       19       30       35       41       42       44       47       56       67       81       82       84       87       88       104       112       115       121       122       124         911       7       11       19       30       35       41       42       44       47       56       69       81       82       84       87       88       104       112       115       121       122       133       33       43       49       50       52       55       67       69       70       81       82       84       87       97       98       110       111 <td>30-23.255</td> <td>7 1</td> <td>1 1</td> <td></td> <td>14 2</td> <td>1 2</td> <td>6 2</td> <td>ж Э</td> <td>1 35</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>62</td> <td>98</td> <td></td> <td></td> <td>٠.</td> <td></td> <td>121</td> <td><math>\neg</math></td> <td>124</td> <td></td>	30-23.255	7 1	1 1		14 2	1 2	6 2	ж Э	1 35							62	98			٠.		121	$\neg$	124	
867       7       7       11       19       30       35       41       42       44       47       56       59       69       81       82       87       88       104       112       115       121       122       122       122       122       122       122       122       122       122       122       132       122       122       132       1	30-23.866	7 1	1 1		30 3	35 4	1.4	2 4	4 47	5							٠.			٠.		122	-	127	
880 7 11 19 30 35 41 42 44 47 56 59 69 81 82 87 88 104 112 115 121 122 124 899 7 11 19 30 35 37 41 42 44 47 56 67 81 82 87 88 104 112 115 121 122 124 911 7 11 19 30 35 41 42 44 47 56 69 81 82 84 87 88 104 112 115 121 122 124 975 7 19 21 22 35 37 38 49 50 52 55 67 69 70 81 82 84 87 97 98 100 111 976 7 19 21 22 35 37 38 49 50 52 55 67 69 70 81 82 84 87 97 98 111 112 132 132 133 38 49 50 52 55 67 69 70 81 82 84 87 97 98 111 112 133 37 38 49 50 52 55 67 69 70 81 82 84 87 97 98 111 112 133	30-23.867	7 1	1		30 3	35 4	1.4	2.4	4 47	5	6 5	9	57 8		3 4	38 1	٠.	12 1	15 1	-		122	П	127	
899 7 11 19 30 35 37 41 42 44 47 56 67 81 82 87 88 104 112 115 121 122 124 30 11	30-23.880	7 1	1 1		30 3	35 4	1.4	2 4	4 47	5	6 5	9	9 69		22	37	1-1	-	01			122	-	127	
911 7 11 19 30 35 41 42 44 47 56 69 81 82 84 87 88 104 112 115 121 122 124 3975 7 19 21 22 35 37 38 49 50 52 55 67 69 70 81 82 84 87 97 98 100 111 376 7 19 21 22 35 37 38 49 50 52 55 67 69 70 81 82 84 87 97 98 111 112 3	30-23.899	7 1	1 1	9	30 3	5 3	7 4	1 4.	2 44	4	7 5	9	17 8		2	37	Н	04 1	12 1	-		122	-	127	
975 7 19 21 22 35 37 38 49 50 52 55 67 69 70 81 82 84 87 97 98 100 111 3 976 7 19 21 22 35 37 38 49 50 52 55 67 69 70 81 82 84 87 97 98 111 112 3	30-23.911	7 1	1	6 6	ω 0	5 4	1.4	2.4	4 47	S	9 9	8	11 8		4	37	-	04 1	12 1			122	_	127	
3.976 7 19 21 22 35 37 38 49 50 52 55 67 69 70 81 82 84 87 97 98 111 112 3	97	7 1	9	1 2	23	5 3	7 3	8		. 5		_	_		90	31		4	87	26		100	-	112	
	3.97	7 1	9	1 2	23	53	7 3	8 4		ŝ		_			0	1		<b>5</b> 7°	87	97	. 86	111	112	115	

k = 31, Designs sorted based on word length pattern

Design	W1D (W4,)	7	wlp							alp	_							df C2	FI	C2FI Lmax	df	CZFI	Lmax	CD2*	CD2
			rank							•											rank	rank	rank		rank
31-24.1	391 1134 5	5826	1	0	0	0	4 4	8	0	0	0	0	m	4	0	0	0	118	0	12	323	331	96	5.3525	7
31-24.2	1134	5827	2	0	0	0	4 4	80	0	0	0	0	m	4	0	0	0	118	0	12	324	332	97	5,3525	7
31-24.3	392 1132 5	5817	m	0	0	0	6.4	4 1(	0	_	0	0	4	7	н	0	0	118	0	13	325	333	174	5,3531	ო
31-24.4	1134	5815	4	0	0	0	9;	4 1(	0	0	0	0	4	7	-	0	0	118	0	13	326	334	175	5.3532	S
31-24.5	1136	5817	Ŋ	0	0	0	6 4	4 1(	0	0	0	0	7	7	Н	0	0	118	0	13	327	335	176	5.3533	9
31-24.6	1132	5804	9	0	0	0	8.4	0	2	0	0	0	S	0	7	0	0	118	0	13	328	336	177	5.3537	œ
31-24.7	1136	5804	7	0	0	0	28 4	0 12	0	0	0	0	ა	0	7	0	0	118	0	13	329	337	178	5.3540	თ
31-24.8	1132	5793	œ	0	0	0	30 3	36 14	4	0	0	0	2	Н	0	Н	0	118	0	14	330	338	275	5.3543	10
31-24.9	1136	5793	6	0	0	0	30 3	6 1	4	0	0	0	2	Н	0	Н	0	118	0	14	331	339	276	5,3546	11
31-24.10	1128	5760	10	0	0	0	36 2	4 2	0	0	0	0	9	0	0	0	_	118	0	15	332	340	399	5.3560	14
31-24.11	1136	5760	11	0	0	0	36 2	4 2	0	0	0	0	9	0	0	0		118	0	15	333	341	400	5.3566	19
31-24.12	1102	5906	12	0	0	4	36 3	4 1	5	0	0	0	7	'n	0	0	0	118	0	12	334	342	86	5.3557	12
31-24.13	1103	5906	13	0	0	4	26 3	4 1	5	0	0	0	7	2	0	0	0	118	0	12	335	343	66	5.3557	13
31-24.14a	1102	5894	14	0	0	9	22.3	6 1	5	0	0	0	m	m	<del></del>	0	0	118	0	13	336	344	179	5,3563	15
31-24.14b	1102	5894	14	0	0	4	38.3	0	7 1	0	0	0	က	ო	Н	0	0	118	0	13	336	344	179	5,3563	15
31-24.16	1103	5894	16	0	0	9	22 3	16 1	5 1	0	0	0	ო	m	_	0	0	118	0	13	338	346	181	5.3564	17
31-24.17	1104	5894	17	0	0	4	28 3	30 1.	7 1	0	0	0	က	က	7	0	0	118	0	13	339	347	182	5.3564	18

k=31, Designs sorted based on degrees of freedom used

CD2 rank	47	163	149	164	183	206	229	241	4
CD2*	5.3625	5,3756	5.3742	5.3757	5.3768	5.3789	5.3810	5.3821	5,3531
Lmax rank	28	220	102	103	221	225	227	324	283
C2FI rank	371	237	250	251	252	243	244	236	264
df rank		7	ო	4	ഹ	9	7	œ	on.
Lmax	11	13	12	12	13	13	13	14	14
C2FI	0	12	ω	80	80	11	11	13	9
df c	127	127	125	125	125	125	125	125	124
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	-	٦
	0	m	0	0	Н	m	ო	7	0
	0	0	9	9	Ŋ	0	H	0	0
	10	0	0	Н	0	4	က	4	0
	0	6	Н	0	Н	0	0	0	0
	0	0	0	9	9	0	9	9	0
alp	5	m	15	7	7	15	2	7	9
	0	0	0	16	16	0	16	16	24
	0	33	0	0	0	0	0	0	27
	51	0	0	0	0	14	16	18	m
	0	က	33	33	37	10	9	7	0
	0	24	16	16	ω	22	24	28	0
	30	Q	9	9	10	9	9	7	26
	0	12	80	œ	æ	11	11	13	9
wlp rank									37
	6148	6688	6549	6576	6552	6772	6788	6768	7637
wlp (w4,)	410 1060	439 914	434 952	437 940	439 938	445 892	449 880	451 878	408 848 7637
Design	31-24.43	31-24.104	31-24.86	31-24.99	31-24.105	31-24.119	31-24.125	31-24.130	31-24.37

k=31, Designs sorted based on the number of clear two-factor interactions

)esign	wlķ	wlp (w4,)	wiprank							п	alp								df C2	H	CZFI LMax dt rank	df rank	C2FI rank	Lmax rank	CD2*	CD2 rank
31-24.433	819 1	26 1456		59	0	0	0	0	0	0	0		0	0	0 2			0		6	14	313	4	398	5.6579	433
-24.390	525 4	20 887		37	0	0	0	0	14	19 1	15	0	0	0	0	7	ر د	1		17	13	234	7	267	5.4124	376
31-24.397	531 4	531 414 8896	96 397	37	0	0	0	9	~	32	7	9	0	0	0	vo.	_	1 (	123 3	37	14	236	m	381	5.4165	387
-24.401	539 4	406 896		36	0	0	0	9	18	0	17	7	0	0	0	 10	7	0 1		9	14	304	4	382	5.4223	396
-24.412	563 3	82 916			0	0	0	24	0	0	0	24	0	0	0	- T	3	1 (		35	14	312	S	386	5.4401	412
-24.429	643 3	02 1067			7	24	0	0	0	0	0	0	0	4	7	, Edi	_			35	14	252	છ	395	5.5057	429
-24.422	591 3	54 974		34	7	0	24	0	0	0	0	0	7	0	-	5		1		34	14	308	7	391	5.4633	422
-24.431	719 2	26 1217			26	0	0	0	0	0	0	0	0	0	'n	ر. د	_	1		4	14	310	00	397	5,5695	431

k = 31, Designs sorted based on minimizing Lmax

CD2	65	75	26	59	99	79	82	83
CD2* (	5.3661	.3673	.3637	.3649	.3661	.3684	5.3685	.3686
Lmax rank	1 5	2 5	3	4 5	5	9		8
C2FI rank	44	48	42	43	44	20	52	53
df rank	45	49	43	44	45	51	53	54
Lmax	g)	σ	10	10	10	10	10	10
C2FI	30	30	30	30	30	30	30	30
df	123	123	123	123	123	123	123	123
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	r	П	က	Н	7	-
Q,	7	Ø	0	4	Н	10	9	10
alp	18	15	œ	14	15	10	16	10
	12	15	40		24	20	14	20
	19	14	œ	13	16	10	17	10
	9	σ	Н	4	0	11	ß	1
	0	0	7	ч	٣		7	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	30	30	30	30	30	30	30	30
wlprank							144	
wlp (w4,)	9208	9188	9240	9224	9208	9160	9172	9184
W.	94	92	86	96	94	90	90	90
wlŗ	451 4	453 4	447 4	449 4	451 4	455 4	455 490 9172	455 4
Design	31-24.128a							

k = 31, Design generators

1 7 11 19 21 22 25 26 35 45 46 49 60 67 711 19 29 30 35 41 44 47 53 54 56 67 71 19 29 30 35 41 44 47 53 54 56 67 71 19 29 30 35 41 44 47 53 54 56 67 71 19 29 30 35 41 47 53 54 56 59 77 82 77 11 19 29 30 35 41 47 53 54 56 59 77 82 77 11 19 29 30 35 41 47 53 54 56 57 79 85 77 11 19 29 30 35 41 47 53 54 56 67 79 85 80 77 11 19 29 30 35 41 47 53 54 56 67 79 85 10 77 11 19 29 30 35 41 47 53 54 59 77 82 11 19 29 30 35 41 47 53 54 56 57 79 85 11 19 29 30 35 41 47 53 54 56 57 79 85 11 19 29 30 35 41 47 53 54 56 57 77 82 11 19 29 30 35 41 47 53 54 56 59 77 11 19 29 30 35 41 47 53 54 56 59 77 11 19 29 30 35 41 47 53 54 56 59 77 11 19 29 30 35 41 47 53 54 56 59 77 11 19 29 30 35 41 47 53 54 56 59 77 11 19 29 30 35 41 47 53 54 56 59 77 11 19 29 30 35 41 47 53 54 56 59 77 11 19 29 30 35 41 47 53 54 56 59 77 11 19 29 30 35 41 47 53 54 56 59 77 11 19 29 30 35 41 47 53 54 56 59 77 11 19 29 30 35 41 42 44 49 50 55 51 11 19 29 30 35 41 42 44 55 56 67 70 85 105 71 11 19 20 30 35 41 47 53 54 56 59 77 11 19 20 30 35 41 42 44 54 56 59 67 70 11 19 20 30 35 41 42 53 56 67 70 85 11 19 71 11 19 20 30 31 34 40 50 55 50 50 50 50 50 50 50 50 50 50 50	Design										Desi	igi	Gene	Generator	rs								
14.2 7111 19 29 30 35 41 44 47 53 55 86 67 77 78 81 81 84 104 107 112 112 112 113 119 19 30 35 41 44 47 53 54 56 97 78 82 84 88 102 103 104 107 112 113 12 13 11 19 29 30 35 45 46 56 97 78 82 84 88 102 102 104 107 112 113 113 113 10 10 10 10 10 10 10 10 10 10 10 10 10	31-24.1		-	ام	Iユ		m	5 45	3 46	49		1	77	78	81		ı¬	108	, ,	Г.	-	3 12	9
4, 3         7 1119         29         39         44         55         56         67         86         97         98         10         102         10         10         20         30         35         44         47         55         46         65         97         98         10         102         10         10         10         20         30         35         44         47         55         56         67         98         88         10	- CI*		Ч	0	•		4	4		54			77	78			6-4	112	•		-	4 12	7
4, 4         71119         29         39         44         47         53         45         59         77         82         84         89         10 <t< td=""><td>***</td><td>7</td><td>11 1</td><td>σ</td><td>d)</td><td></td><td>4</td><td>5</td><td></td><td>58</td><td></td><td></td><td>86</td><td>92</td><td></td><td></td><td></td><td>104</td><td></td><td>_</td><td>~</td><td>5 12</td><td>S.</td></t<>	***	7	11 1	σ	d)		4	5		58			86	92				104		_	~	5 12	S.
4, 6         7,1119         20         30         35         44         75         35         45         66         87         98         100         100         101         112         113         21         119         29         30         35         45         46         53         57         86         06         90         10	4	7	11 1	0	•		4	2	ß	വ			82	84			$\vdash$	112		177	Н	4 12	7
4, 6 7 11 19 29 30 35 45 46 53 57 58 60 67 86 95 97 98 100 103 104 107 112 115 114 119 29 30 35 49 50 52 55 60 60 63 67 86 91 101 102 104 107 112 115 121 124 14. 7 11 19 29 30 35 41 47 53 54 56 97 86 86 101 102 104 107 112 121 122 124 14. 7 11 19 29 30 35 41 47 53 54 87 78 82 84 88 101 102 104 107 112 121 122 124 111 12 29 30 35 41 47 53 59 78 82 84 88 101 101 102 104 107 112 121 122 124 111 12 29 30 35 41 47 53 59 78 82 84 88 101 102 104 107 112 121 122 124 14. 8	4	7	11 1	o	0		S	2	S	വ			84	88			-	112		_	П	4 12	7
4,7 7 719 29 30 35 49 50 52 55 66 77 9 85 86 88 101 102 104 107 112 112 112 113 119 29 30 35 44 46 53 57 58 67 70 82 84 88 91 102 104 107 112 112 112 112 113 111 19 29 30 35 41 47 53 59 78 82 84 88 91 102 104 107 112 112 112 112 113 111 19 29 30 35 41 47 53 59 78 82 84 88 101 102 104 107 112 112 112 112 114 111 19 29 30 35 41 47 53 54 65 97 78 82 84 88 101 102 104 107 112 112 112 114 114 114 115 111 111 115 111	4	7	11 1	6	0		4	2	S	ນ			86	92			-	104	٠.		Н	5 12	2
4.8 7 111 19 29 30 35 45 46 53 57 58 60 63 67 86 97 98 100 103 104 107 112 121 122 124 4.110 7 111 19 29 30 35 41 47 53 59 78 82 84 88 91 101 102 104 107 112 121 122 124 4.111 19 29 30 35 41 47 53 59 78 82 84 88 101 102 104 107 112 121 122 124 4.113 7 111 19 29 30 35 41 47 53 59 78 82 84 88 102 104 107 112 121 122 124 4.113 7 111 19 29 30 35 41 47 53 56 59 77 82 84 88 102 104 107 112 121 122 124 4.114 7 111 19 29 30 35 41 47 53 54 56 59 77 82 84 88 102 104 107 112 121 122 124 4.114 7 111 19 29 30 35 41 47 53 54 56 59 77 82 84 88 102 104 107 112 121 122 124 4.114 7 111 19 29 30 35 41 47 53 54 56 59 77 82 84 88 102 104 107 112 121 122 124 4.114 7 111 19 29 30 35 41 47 53 54 56 59 77 82 84 88 91 102 104 107 112 121 122 124 4.137 7 111 19 20 30 35 37 38 44 42 49 67 67 77 81 84 89 102 104 107 112 121 122 124 4.137 7 111 19 29 30 35 37 38 44 42 49 67 67 67 84 104 107 112 121 122 124 4.137 7 111 19 29 30 35 37 38 44 42 49 67 69 70 73 79 81 84 99 50 70 103 109 117 120 124 4.137 7 111 19 29 30 35 37 38 44 49 50 52 56 67 69 81 84 90 100 103 109 117 120 120 124 4.139 7 111 19 29 30 35 37 38 44 49 50 52 55 66 67 69 81 84 90 50 710 112 121 122 124 4.118 7 111 13 14 12 12 12 12 12 12 12 12 12 12 12 12 12	4	7	19 2	6	0		S	5	S	0			86	88				115	٠.	_		٠.	7
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-24,128b         7 11 13 14 21 26 31 35 41 52 56 59 61 69 74 79 86 97 103 104 112 121 122           -24,130         7 13 19 21 22 25 35 37 38 41 49 50 52 55 66 7 69 81 84 95 97 111 112           -24,135         7 11 13 14 21 26 28 31 35 41 52 56 59 61 67 79 86 97 103 104 112 121 122           -24,142         7 11 13 14 19 25 28 31 35 38 47 49 56 59 61 67 79 85 98 104 109 112 121 122           -24,144         7 11 13 14 19 25 28 31 35 38 47 49 56 52 69 67 85 98 104 109 112 121 122           -24,300         7 11 19 30 35 37 41 42 44 47 56 67 81 82 84 87 88 104 107 112 115 121 122           -24,412         7 11 19 30 35 37 41 42 44 47 56 67 81 82 84 87 88 104 112 115 121 122 124           -24,421         7 11 19 30 35 37 41 42 44 47 56 67 81 82 84 87 88 104 112 115 121 122 124           -24,422         7 11 19 30 35 37 41 42 44 47 56 67 81 82 84 87 88 104 112 115 121 122 124           -24,432         7 11 19 30 35 37 41 42 44 47 56 67 81 82 84 87 88 104 112 115 121 122 124           -24,432         7 11 19 30 35 37 41 42 44 47 56 67 81 82 84 87 88 104 112 115 115 115 115 112 115 115 115 115	-24.	7	11 1	13 3				m	ന	4				69	79	86	• •	104		٠.			4
-24.136         7 13 19 21 22 25 35 37 38 41 49 50 52 55 56 67 69 81 84 95 97 111 112           -24.135         7 11 13 14 21 26 28 31 35 41 52 56 59 61 69 79 86 97 103 104 112 121 122           -24.142         7 11 13 14 19 25 28 31 35 38 47 49 56 59 61 67 78 82 84 98 104 109 112 121 122           -24.144         7 11 13 14 19 25 28 31 35 38 42 49 50 52 59 67 85 98 104 109 112 121 121 122           -24.390         7 11 19 30 35 37 41 42 44 47 56 67 81 82 84 87 88 104 107 112 115 121 122 124           -24.401         7 11 19 30 35 37 41 42 44 47 56 67 81 82 84 87 88 104 112 115 121 122 124           -24.412         7 11 19 30 35 37 41 42 44 47 56 67 81 82 84 87 88 104 112 115 121 122 124           -24.422         7 11 19 30 35 37 41 42 44 47 56 67 81 82 84 87 88 104 112 115 121 122 124           -24.432         7 11 19 30 35 37 41 42 44 47 56 67 81 82 84 87 88 104 112 115 121 122 124           -24.432         7 11 19 30 35 37 41 42 44 47 56 67 81 82 84 87 88 104 112 115 121 122 124           -24.432         7 12 12 23 37 38 49 50 52 56 67 69 70 81 82 84 97 88 111 112 115 115 115 115 115 115 115 115	24.	7	11	13.	14 2			4	വ	വ				74				104					4
-24,135         7 11 13 14 21 26 28 31 35 41 52 56 59 61 67 78 86 97 103 104 112 121 122           -24,142         7 11 19 21 22 25 31 35 38 47 49 56 59 61 67 78 82 84 98 103 112 121 122           -24,144         7 11 13 14 19 25 28 31 35 38 47 49 56 59 61 67 79 85 98 104 109 112 121 122           -24,145         7 11 13 14 19 28 31 35 38 42 49 50 52 59 67 79 85 98 104 109 112 121 122           -24,145         7 11 19 30 35 37 41 42 44 75 56 67 81 82 84 87 88 104 112 115 121 122 124           -24,390         7 11 19 30 35 37 41 42 44 75 56 67 81 82 84 87 88 104 112 115 121 122 124           -24,401         7 11 19 30 35 37 41 42 44 47 56 67 81 82 84 87 88 104 112 115 121 122 124           -24,422         7 11 19 30 35 37 38 41 44 47 56 81 82 84 87 88 91 104 112 115 121 122 124           -24,423         7 19 21 22 35 37 38 49 50 52 56 67 69 70 81 82 88 97 98 111 112 115 115 115 115 115 115 115 115	-24.1	7	13		-			m	4	4				56				95		7 11			9
-24,142         7 11 19 21 22 25 31 35 38 47 49 56 59 61 67 78 82 84 98 103 112 121 122           -24,144         7 11 13 14 19 25 28 31 35 38 47 49 56 59 67 79 85 98 104 109 112 121 122           -24,145         7 11 13 14 19 28 31 35 38 42 49 50 52 59 67 79 85 98 104 109 112 121 122           -24,145         7 11 19 30 35 37 41 42 44 47 56 67 81 82 84 87 88 104 112 115 121 122 124           -24,390         7 11 19 30 35 37 41 42 44 47 56 67 81 82 84 87 88 104 112 115 121 122 124           -24,401         7 11 19 30 35 37 41 42 44 47 56 67 81 82 84 87 88 104 112 115 121 122 124           -24,422         7 11 19 30 35 37 38 49 50 52 56 67 69 70 81 82 88 91 104 112 115 121 122 124           -24,431         7 19 21 22 35 37 38 49 50 52 56 67 69 70 81 82 88 97 98 111 112 115 115 115 115 115 115 115 115	-24.1	7	11		4			m	4	S				69				104	11	2 12			4
-24.144         7 11 13 14 19 25 28 31 35 38 42 49 50 52 59 67 79 85 98 104 109 112 121 122           -24.145         7 11 13 14 19 28 31 35 38 42 49 50 52 59 62 67 85 98 104 109 112 121 122           -24.390         7 11 19 30 35 37 41 42 44 47 56 67 81 82 84 87 88 104 112 115 121 122 124           -24.397         7 11 19 30 35 41 42 44 47 56 67 81 82 84 87 88 104 112 115 121 122 124           -24.401         7 11 19 30 35 37 41 42 44 47 56 67 81 82 84 87 88 104 112 115 121 122 124           -24.422         7 11 19 30 35 37 38 41 42 44 47 56 81 82 84 87 88 91 104 112 115 121 122 124           -24.431         7 19 21 22 35 37 38 49 50 52 56 67 69 70 81 82 84 87 98 91 104 112 115 112 115 115 115 115 115 115 115	N	7	디		Н			ന	4	4				67				103	11	2 12			4
-24,145         7 11 13 14 19 28 31 35 38 42 49 50 52 59 62 67 85 98 104 109 112 121 122           -24,390         7 11 19 30 35 37 41 42 44 47 56 67 81 82 87 88 104 107 112 115 121 122 124           -24,397         7 11 19 30 35 41 42 44 47 56 67 81 82 84 87 88 104 112 115 121 122 124           -24,401         7 11 19 30 35 37 41 42 44 47 56 67 81 82 84 87 88 104 112 115 121 122 124           -24,402         7 11 19 30 35 37 41 42 44 47 56 81 82 84 87 88 91 104 112 115 121 122 124           -24,422         7 11 19 30 35 37 38 41 42 44 47 81 82 84 87 88 91 104 112 115 121 122 124           -24,423         7 19 21 22 35 37 38 49 50 52 56 67 69 70 81 82 88 97 98 111 112 115 115 115           -24,431         7 19 21 22 35 37 38 49 50 52 55 66 7 69 70 81 82 84 87 97 98 111 112 115 115           -24,433         7 19 21 22 35 37 38 49 50 52 55 66 7 69 70 81 82 84 87 97 98 111 112 115           -24,433         7 19 21 22 35 37 38 49 50 52 55 66 7 69 70 81 82 84 87 97 98 100 111 112	Ñ	7	11	13	14 ]			က	സ	4				67			٢	109	Н		-	~	4
-24,390         7 11 19 30 35 37 41 42 44 47 56 67 81 82 87 88 104 107 112 115 121 122 124           -24,397         7 11 19 30 35 41 42 44 47 56 59 69 81 82 84 87 88 104 112 115 121 122 124           -24,401         7 11 19 30 35 37 41 42 44 47 56 67 81 82 84 87 88 104 112 115 121 122 124           -24,401         7 11 19 30 35 37 41 42 44 47 56 81 82 84 87 88 91 104 112 115 121 122 124           -24,422         7 11 19 30 35 37 38 41 42 44 47 81 82 84 87 88 91 104 112 115 121 122 124           -24,423         7 19 21 22 35 37 38 49 50 52 56 67 69 70 81 82 88 97 89 111 112 115 115 117           -24,431         7 19 21 22 35 37 38 49 50 52 55 56 67 69 70 81 82 84 87 97 98 111 112 115 115           -24,431         7 19 21 22 35 37 38 49 50 52 55 56 67 69 70 81 82 84 87 97 98 111 112 115           -24,433         7 19 21 22 35 37 38 49 50 52 55 56 67 69 70 81 82 84 87 97 98 100 111 112	-2	7	11	m					8 42	4				62			Н	109	-		Н	C)	4
-24.397         7 11 19 30 35 41 42 44 47 56 59 69 81 82 84 87 88 104 112 115 121 122 124           -24.401         7 11 19 30 35 37 41 42 44 47 56 67 81 82 84 87 88 104 112 115 121 122 124           -24.412         7 11 19 30 35 37 41 42 44 47 56 81 82 84 87 88 104 112 115 121 122 124           -24.422         7 11 19 30 35 37 38 41 42 44 47 81 82 84 87 88 91 104 112 115 121 122 124           -24.429         7 19 21 22 35 37 38 49 50 52 56 67 69 70 81 82 84 97 98 111 112 115 117           -24.433         7 19 21 22 35 37 38 49 50 52 55 67 69 70 81 82 84 97 98 111 112 115 115           -24.433         7 19 21 22 35 37 38 49 50 52 55 67 69 70 81 82 84 97 98 111 112 115           -24.433         7 19 21 22 35 37 38 49 50 52 55 67 69 70 81 82 84 97 98 100 111 112	-24.39	7	11	თ				-	4 4	S				87			-	115	П		Н	<b>~</b> #	7
-24,401     7 11 19 30 35 37 41 42 44 47 56 67 81 82 84 87 88 104 112 115 121 122 124       -24,412     7 11 19 30 35 37 41 42 44 47 56 81 82 84 87 88 91 104 112 115 121 122 124       -24,422     7 11 19 30 35 37 38 41 42 44 47 81 82 84 87 88 91 104 112 115 121 122 124       -24,429     7 19 21 22 35 37 38 49 50 52 56 67 69 70 81 82 84 97 98 111 112 115 117       -24,431     7 19 21 22 35 37 38 49 50 52 55 66 7 69 70 81 82 84 97 98 111 112 115 115       -24,431     7 19 21 22 35 37 38 49 50 52 55 67 69 70 81 82 84 97 98 111 112 115       -24,431     7 19 21 22 35 37 38 49 50 52 55 67 69 70 81 82 84 97 98 100 111 112	-24.3	7	11	6				•	7 56	ഗ				84			М	115	-		М	~	7
-24.412     7 11 19 30 35 37 41 42 44 47 56 81 82 84 87 88 91 104 112 115 121 122 124       -24.422     7 11 19 30 35 37 38 41 42 44 47 81 82 84 87 88 91 104 112 115 121 122 124       -24.429     7 19 21 22 35 37 38 49 50 52 56 67 69 70 81 82 88 97 98 111 112 115 117       -24.431     7 19 21 22 35 37 38 49 50 52 55 66 67 69 70 81 82 84 97 98 111 112 115       -24.431     7 19 21 22 35 37 38 49 50 52 55 67 69 70 81 82 84 97 98 101 112 115       -24.433     7 19 21 22 35 37 38 49 50 52 55 67 69 70 81 82 84 87 97 98 100 111 112	-24.4	7	11	9				2.4	4.4	S				84			Н	115	$\vdash$	٠.	<del></del> 1	<"	7
-24.422     7 11 19 30 35 37 38 41 42 44 47 81 82 84 87 88 91 104 112 115 121 122 124       -24.429     7 19 21 22 35 37 38 49 50 52 56 67 69 70 81 82 88 97 98 111 112 115 117       -24.431     7 19 21 22 35 37 38 49 50 52 55 6 67 69 70 81 82 84 97 98 111 112 115       -24.433     7 19 21 22 35 37 38 49 50 52 55 67 69 70 81 82 84 87 97 98 100 111 112	-24.4	7	11		0			2.4	4 4	വ				87			Н	115		٠.	-	<	7
4.429 7 19 21 22 35 37 38 49 50 52 56 67 69 70 81 82 88 97 98 111 112 115 117 4.431 7 19 21 22 35 37 38 49 50 52 55 56 67 69 70 81 82 84 97 98 111 112 115 115 4.433 7 19 21 22 35 37 38 49 50 52 55 67 69 70 81 82 84 87 97 98 100 111 112	-24.4	7	11		0			-	2 44	4			00	87			Н	115	~		-	℧	7
4.431 7 19 21 22 35 37 38 49 50 52 55 56 67 69 70 81 82 84 97 98 111 112 115 4.433 7 19 21 22 35 37 38 49 50 52 55 67 69 70 81 82 84 87 97 98 100 111 112	-24.4	7	19	21 ;					0 5%	ഗ			7	81				111	11	2 11	Н	7	00
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	4.4	7		21 ,				Ŋ	Ŋ	വ			7	81				86	$\vec{\vdash}$	0 11	Н	7	īÚ

k = 32, Designs sorted based on word length pattern

3       0       0       119       0       13       130       125       46       4.8919         1       3       0       0       119       0       13       131       126       47       4.8920         1       1       0       0       119       0       14       133       128       75       4.8925         1       1       0       0       119       0       14       133       128       76       4.8926         5       0       0       1       0       119       0       15       135       130       127       4.8926         6       0       0       1       0       15       135       130       128       4.8926         6       0       0       1       0       15       135       131       128       4.8936         6       0       0       0       1       0       13       131       13       13       13       4.8949         7       1       0       0       1       0       14       140       135       77       4.8949         8       0       0       0 <t< th=""></t<>
119 0 13 132 125 47 48 41 119 0 14 133 128 75 41 119 0 14 134 129 76 41 119 0 15 135 130 127 41 119 0 15 136 139 134 77 41 119 0 14 140 135 78 41 119 0 13 142 136 51 41 119 0 14 140 135 78 41 119 0 14 140 135 78 41 119 0 14 143 138 51 41 119 0 14 143 138 51 41 119 0 14 143 138 51 41 119 0 14 143 138 51 41 119 0 14 143 138 51 41 119 0 14 143 138 51 41 119 0 14 143 138 51 41 119 0 14 143 138 51 41 143 143 143 143 143 143 143 143 143
119 0 13 132 127 48 119 0 14 133 128 75 119 0 14 134 129 76 119 0 15 135 130 127 119 0 15 135 130 127 119 0 13 138 139 134 17 119 0 14 140 135 78 119 0 14 140 135 78 119 0 14 140 135 78 119 0 14 143 138 51 119 0 14 143 138 51 119 0 14 143 138 51 119 0 14 143 138 51 119 0 14 143 138 51 119 0 14 143 138 51 14 143 138 51 14 143 138 51 14 143 138 51 14 143 138 51 14 143 138 51 14 143 138 51 14 143 138 51 14 143 138 51 14 143 138 51 14 143 138 51 14 143 138 51 14 143 138 51 14 143 138 51 14 143 138 51 14 143 138 51 14 143 138 51 14 143 138 51 14 14 143 138 51 14 14 14 14 14 14 14 14 14 14 14 14 14
119 0 14 133 128 75 4 119 0 14 134 129 76 119 0 15 135 130 127 4 119 0 13 137 132 49 119 0 14 139 134 77 4 119 0 14 140 135 78 119 0 13 142 137 52 4 119 0 14 143 138 51 4 140 136 51 4 140 140 140 140 140 140 140 140 140
119 0 14 134 129 76 4 119 0 15 135 130 127 4 119 0 15 136 131 128 4 119 0 13 138 134 77 4 119 0 14 140 135 78 4 119 0 13 141 136 51 4 119 0 13 142 137 52 4 119 0 14 143 138 51 4 119 0 14 143 138 51 4 119 0 14 143 138 51 4 119 0 14 143 138 51 4 119 0 14 143 138 51 4 119 0 14 143 138 51 4 119 0 14 143 138 51 4 119 0 14 143 138 51 4 119 0 14 143 138 51 4 119 0 14 143 138 51 4 119 0 14 143 138 51 4 119 0 14 143 138 51 4 119 0 14 143 138 51 4 119 0 14 143 138 51 4 119 0 14 143 138 51 4 119 0 14 143 138 51 4 14 143 138 51 4 14 14 14 14 14 14 14 14 14 14 14 14
119 0 15 135 130 127 4 119 0 15 136 131 128 4 119 0 13 137 132 49 4 119 0 14 139 134 77 4 119 0 14 140 135 78 4 119 0 13 141 136 51 4 119 0 13 142 137 52 4 119 0 14 143 138 79 4
119 0 15 136 131 128 49 41 119 0 13 137 132 49 41 119 0 13 138 133 50 41 119 0 14 140 135 78 41 119 0 13 142 137 52 41 119 0 14 143 138 79 41 119 0 14 143 138 79 41 136 71 41 41 136 71 41 41 136 71 41 41 41 41 41 41 41 41 41 41 41 41 41
119 0 13 137 132 49 4 119 0 13 138 133 50 4 119 0 14 139 134 77 4 119 0 14 140 135 78 4 119 0 13 141 136 51 4 119 0 14 142 137 52 4 119 0 14 143 138 79 4
119 0 13 138 133 50 4 119 0 14 139 134 77 4 119 0 14 140 135 78 4 119 0 13 141 136 51 4 119 0 14 143 138 75 4 119 0 14 143 138 75 4
119 0 14 139 134 77 4 119 0 14 140 135 78 4 119 0 13 141 136 51 4 119 0 13 142 137 52 4 119 0 14 143 138 79 4 119 0 14 143 138 79 4 119 0 14 143 138 79 4 119 0 14 143 138 79 4 119 0 14 143 138 79 4 119 0 14 143 138 79 4 119 0 14 143 138 79 4 119 0 14 143 138 79 4 119 0 14 143 138 79 4 119 0 14 143 138 79 4 119 0 14 14 14 14 14 14 14 14 14 14 14 14 14
119 0 14 140 135 78 4 119 0 13 141 136 51 4 119 0 13 142 137 52 4 119 0 14 143 138 79 4 119 0 14 143 138 79 4 119 0 14 143 138 79 4 119 0 14 143 138 79 4 119 0 14 143 138 79 4 119 0 14 143 139 79 4 119 0 14 14 14 14 14 14 14 14 14 14 14 14 14
119 0 13 141 136 51 4 119 0 13 142 137 52 4 119 0 14 143 138 79 4
119 0 13 142 137 52 4 119 0 14 143 138 79 4
0 14 143 138 79 4
A 00 051 AAT AT 0
0 T4 T44 T23 00 4

k=32, Designs sorted based on degrees of freedom used

Design	wlp(w4,)	<u>-</u>	wlp rank								alp								df c	CZFI	Lmax	df cank	C2FI rank	Lmax rank	CD2*	CD2 rank
32-25.66	1080	8232	99	8	9	œ	- 1	-	1	0	7			0	9	0	0	0	126		13	-1	92	57	4.9180	97
32-25.76	1012	8504	97	11	m	25	2		0	0	7	0		4	0	٣	0	0	126	11	14	7	88	107	4.9225	115
32-25.25	916	9510	25	4	28	0	0			3 1,	4			0	0	0	П	0	125	4	15	m	86	131	4.8919	
32-25.42	489 940	9408	42	4	28	0	0	12 1	18	0 17	7 13	o ~	0	0	0	0	7	0	125	4	15	4	66	135	4.9007	27
32-25.57	916	9340	57											0	0	0	~	0	125	4	15	S	100	139	4.9065	44
32-25.60	912	9382	9	4		0	12			3 2				0	0	0	Н	0	125	4	15	9	101	141	4.9078	52
32-25.61	806	9344	61											0	0	0	Н	0	125		15	7	102	142	4.9086	26
32-25.64	904	9354	64		28								٦	0	0	0	-1	0	125		15	ω	104	145	4.9097	62
32-25.71	568 1	1424	71	31		0								0	0	0	0	0	125	31	11	6	17	2	4.9035	34
32-25.73	380	9382	73	4										0	0	0	-	0	125		15	10	105	149	4.9162	88

k=32, Designs sorted based on the number of clear two-factor interactions

Design	wlp (w4,)	-	wlp rank							10	alp								df		C2FI Lmax	ıx df rank	C2FI k rank			CD2*	CD2 rank
32-25, 197	945 140 1	18200	197	61	0	0	0	0	0	0	0		0	0	0	30	7-1	0	124	19	15	10		18	5.	2139	197
32-25,178	609 476 3	11032		38	0	0			7 1	7 1		0 /		0	0	7	0	0	125	33	3 14	80	.,	2 12	4	9554	172
55.180	625 460	11160		37	0	0	0	0	4	0	0		0	0	0	9	-	0	124	'n	7 15	101		3 177	4.	9659	177
32-25.184	633 452	11640		34	0	4		19	0	ő	0	119	5	4	0	<u>د</u>	0	0	125	34	1 14	80		4 12	4	3742	185
189	681 404	12280		34	m	-	24	0	0	Õ	0		24	-	ω.	m	0	0	125		1 14	6	-	5 12	2	7700	189
32-25,194	745 340	13432		34	m	25		0	0	0	0	0	0	25		m	0	0	125						Ŋ	0549	194
32-25.186	641 444	11576		33	4	0	0	24	0	0	0	24	0	0	4	7	-	0	124	1 33	3 15			7 17	4	.9785	186
32-25.196	833 252	15288			28	0	0	0	0	0	0	_	0	0	28	2	Н	0	124					8 18	S	1225	196
32-25 89	529 556	11320			C	0		_	13 1	7 1		ر س	0	0	0	1	0	0	125				80	9 11	4	6606	64
32-25,123	545 540 11224	11224	123	32	0	0	0	12	1	7 1	17	1 12	0	0	0	1	0	0	125				4 1	0 11	4	9187	101

k=32, Designs sorted based on minimizing Lmax

Design	W1D (W4)	wlb						alp								df (	SEI	C2FI Lmax	df	CZFI	Lmax	CD2*	CD2
	4	rank						•											rank	rank	rank		rank
32-25.75	521 564 11392	75	31	0	0	0	3 13 15 1	5 13	3	0	0	0	0	0	0	125	31	10	12	19	1	4.9056	41
32-25.79c	525 560 11336		31	0	0	0	6 10 15 1	15 10	9	0	0	0	0	0	0	125	31	10	13	22	7	4.9076	47
32-25.82	525 560 11352		31	0	0	0		15 10	9	0	0	0	0	0	0	125	31	10	15	23	m	4.9077	20
32-25.93	529 556 11344		31	0	0	0	9 7 15 1	15 7	6	0	0	0	0	0	0	125	31	10	22	29	4	4.9101	89
32-25.71	517 568 11424		31	0	0	7		24 4	2		0	0	0	0	0	125	31	11	6	17	2	4.9035	34
32-25.83	525 560 11360		31	0	0	7			-	7	0	0	0	0	0	125	31	11	16	24	9	4.9078	51
32-25.91	529 556 11320		31	0	0	7	15	15 10	4	2	0	0	0	0	0	125	31	11	20	27	7	4.9099	63
32-25.92	529 556 11344	92	31	0	0	ო		12 16	0	m	0	0	0	0	0	125	31	11	21	28	00	4.9100	29
32-25.96	533 552 11288		31	0	0	m	3 13 12 1	12 13	m	m	0	0	0	0	0	125	31	11	24	30	თ	4.9120	71
32-25.98	533 552 11312		31	0	0	7	15		7	2	0	0	0	0	0	125	31	11	26	32	10	4.9122	73

k = 32, Design generators

Design											000	5	Cons	Conorator	2										
32-25.1	7 11				١٣	4 6	46	53	5.4	57	310	5	8 6	000	9	07	,	9	103	104	101	112	٦	125	
2	7 11	1	9 29	9 30	3	5 41	42	47	53	54	26	59	77	82	84	88	102	104	107	112	121	122	124	127	
10	7 11	7			4	1 42	47		54	56			82	84	88	10.			107	112	121	122	-	127	
5	7 11	11			m	5 45	3 46	5 53	54	57			29	98	92	16				104	107	112	Н	125	
25	7 11	1.			3	5 41	1 47	53	54	56	6		82	84		91				112	121	122	-	127	
32-25.6	7 11	ï			m	5 45	3 46		54	57			98	95		26				104	107	112	115	125	
25	7 11	7			m	5 45	3 46		2	57			63	29		26				104	107	112	115	125	
32-25.8	7 11	H	H	4 19			25		m	41			61	29		84				102	108	114	120	123	
32-25.9	7 11	H	3 14	15	21	1 22		26	35	41			61	29	73	84				102	108	111	Н	120	
-2	7 11	7	3 14	1 15			25		m	41			61	29	73	74				102	108	113	Н	120	
-2	7 11	1						7	m	41			61			74				102	108	111		120	
32-25.12	7 11	15					. 42	44	47	53			77			88				112	121	122		127	
ç	7 11	15				-		47	53	54			77			88				112	121	122		127	
32-25.14	7 14	22	2 25	5 26			4		51	53	. 95		77	82	88	26	86			104	112	121	122	124	
32-25.15	7 11	15						53	54	57			17			26				104	107	112		125	
32-25.25	7 11	15					38	41	42	49			69							115	121	122		127	
32-25.42	7 11	13						49	ß	62			82							115	121	122		127	
32-25.57	7 11	13						41		44			73							115	121	122		127	
32-25.60	7 11	13						37	38	41			29							110	117	118		123	
32-25.61	7 11	13							42	44	47		73							115	121	122		127	
5.6	7 11	13							S	59			98							115	121	122		127	
32-25.66	7 13	13	21	. 22					49	20			26							100	106	111		126	
ë.	7 11	13	-						4	49			59							109	112	121		124	
۲.	7 11	13	25						S	59			98							115	121	122		127	
'n	7 11	13	3 14	13						42			25							109	112	121		124	
'n	7 13	19	21	. 22					-	49			22							97	100	111		126	
	7 11	13	7						4	49			61							103	112	121		124	
2-25.	7 11	13	14						38	49			29							109	112	121		124	
32-25.83	7 11	13	H			28	31	35	m	42	49	50	52	59			82			107	112	121		124	
-25.	7 19	22	29	_					4	20			9/			•				115	121	122		127	
-25.	7 11	13	-				31	35	ñ	42		20	25					04 1	. 07	109	112	121		124	
ů.	7 11	13	-					35	m ·				25				79	82	86	104	112	121		124	
-22	7 19	77						42	44	20	67	69	73					07 1	.12	115	121	122		127	
-25.9	7 11	13	9				42	44	47	67	_		9 /			88 1		09		117	121	122		127	
-25.17	7 11	19		• •		-	42	44	47	26			82	84		88 1		107 1	.12	115	121	122	124	127	
-25.18	7 11	13		• •	37	41	42	44	47	26	67 8		82			88	_	04 1	12	115	121	122	124	127	
-25.1	7 11	19	30	٠,	37	41	42	44	47	26	81 8	32	34			93 1	04 1		15	117	121	122	124	127	
-25.	7 11	13	m	٠,	37	41	42	44	47	26	81 8		34	87		91	93 1	_	12	115	121	122	124	127	
-25.1	7 11	19	30	٠,	37	38	41	42	44	47	818		34	87		91			12	115	121	122	124	127	
-25.1	7 19	21	22	35	37	38	49	20	25	26	9 /9	. 69				84		26	98	001	111	112	115	118	
5.1	7 19	21	22	35	37	38	49	20	25		_		. 69	70	-	82	84	97	98	001	111	112	115	118	
32-25.197	7 19	21	22	35	37	38	49	20	52	22	67 6	o				84	87	97	98	001	111	112	115	117	

k=33, Designs sorted based on word length pattern

Design	w]n(w)	alw							ala	_							ľ	df C2	FI	C2FI Lmax	df	CZFI	Lmax	CD2*	CD2
; i	(m) 15 m	rank																			rank	rank	rank		rank
33-26.1	518 1543 8863		0	0	0	1 40	33	m	0	0	0	0	0	5	2	0		20	0	14	29	29	27	4.4789	2
33-26.2	518 1544 8863	2	0	0	0	4 40	33	က	0	0	0	0	0	2	~	_		20	0	14	89	89	28	4.4790	m
33-26.3		က	0	0	0	36	35	m	0	0	0	0	0	9			0 1	20	0	15	69	69	46	4.4794	4
33-26.4	1544	4	0	0	0	6 36	35	က	0	0	0	0	0	9	0	_		20	0	15	70	70	47	4.4795	വ
33-26.5		5	0	0	0	2 30	30	æ	0	0	0	0	0	4	ص ص	0		20	0	14	71	71	29	4.4815	Ø
33-26.6	1512	9	0	0	0	2 30	30	σ	0	0	0	0	0	4	<u>س</u>	0	1	20	0	1.4	72	72	30	4.4815	7
33-26.7		7	0	0	0	4 26	32	œ	0	0	0	0	0	2	_	-	1	20	0	15	73	73	48	4.4820	œ
33-26.8	1500	œ	0	0	0 20	0 12	42	9	0	0	0	0	0	4	_ ლ	0	1	20	0	14	74	74	31	4.4822	თ
33-26.9	1501	6	0	0	0 2	0 12	42	9	0	0	0	0	0	4	_ ص	0	) 1	20	0	14	75	75	32	4.4822	10
33-26.10	1501	10	0	0	0 2	0 12	42	9	0	0	0	0	0	4	e	0	1	20	0	14	97	16	33	4.4822	11
33-26.11	1512	11	0	0	0	8 18	3 36	œ	0	0	0	0	0	9	0	0		20	0	16	77	77	74	4.4830	12
33-26.12	1470	12	0	0	2 1	6 26	5 19	17	0	0	0	0	0	m	4	0	1	20	0	14	78	78	34	4.4848	13
33-26.13	535 1470 9054	13			4 12	2 28	3 19		0	0	0	0	0			_	7	120	0	15	79	79	49	4.4853	14
33-26.14		5 14	2 3	30	0	0	0	30	30	0	0	0	0	0	0		1	26	7	16	43	52	75	4.4784	1
33-26.15	1440	15	0	0	4 1	16 20	32	0	œ	0	0	0	0			0	1	20	0	14	80	80	32	4.4875	16
33-26.16a	542 1440 9130	16	0	0	4 1	8 16	5 34	0	ω	0	0	0	0	m	m	_	0	20	0	15	81	81	20	4.4880	17
33-26,16b	1440	16	0	0	6 1.	2 22	32	0	æ	0	0	0	0	e	٣	_	0	20	0	15	81	81	20	4.4880	17
33-26.18	1440	18	0	0	80	8 2	1 32	0	۵	0	0	0	0	4	П	7	1	20	0	15	83	83	52	4.4885	19
33-26.19	1440	19	0	0	8	0 20	34	0	ω	0	0	0	0	4	2	0	1	20	0	16	84	84	9/	4.4890	20
33-26 20	1400	20	C	_	5	2 38	0	16	œ	0	0	0	0	2	4	_	7	20	0	15	82	82	23	4.4915	22
			,	ı	)	) 	,	l	1																

k = 33, Designs sorted based on degrees of freedom used

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CD2	rank	21	61	24	27	28	30	35	35	35	69	39	39	42	42	44	45	45	20	52	52	55	59	62	63	99	70	71	72	74	75	77	81	83	82		87		93	94	96	
CD2*		4.4900	4.5096	4.	7	4.4937	. 4	4.4962	4.4962	49	4.5138	4.4978	•	4.5004	4.5004	4.5016	4.5018	4.5018	4.5042	4.5055	4.5055	1.5063	4.5083	1.5100	1.5102	1.5121	1.5141	1.5163	1.5179	1.5217	1.5226	1.5259	1.5296	1.5304	1.5376	1.5377	1.5414	1.5456	1.5644	1.5682	1.6017	1.6532
Lmax	rank	7	38	٣	٦	00	7	64	19	4	65	39	σ	2	20	10	11	11	21	40	13	14	22	15	16	29	41	23	9	24	42	25	89	43	17 ,	18	44	70 ,	7 97	71 4	45 4	72 4
CZFI	rank	8	49	6	11	11	13	2	14	14	48	16	16	18	18	20	21	21	23	24	25	26	27	28	59	9	31	32	33	34	35	36	7	38	39	40	11	2	13	က	5	4
df	¥	1	2	e	4	4	9	7	80	8	0	_	-	9													9										. 4		4	•	4	
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I Lmax		2 12	8 14	2 11	2 10	7	1	3 15	Н	Н	1 15	Н		7	2 13	Н	-	-	Н	٦	2 12	Н	_	_	-	-	Н		11	-	Н	13	٦	Н	-	12	-	15	13	15	14	15
df C2FI		1		127 33								127 32			127 32		127 32					127 32		27 32	127 32				127 32							27 32	.27 32	m	7 32	27 35	m	٣
		ļ		0 12					12	12	12	12	12	12	12				•	12			-	-	12	12	12	127	12	12	127	12	12	12	12	12	12	12	12	12	12	12
		_	_	0					0	0	3	0	0	0	0		0	_	0	0	0	0	0	0	0	1 0	0	0	0	0	0	0	1 0	0	0	0	0	7 0	0	3	0	3
			_	0	_				1 0	0	4	0	0	0	1 0	0	0	0	0 1	1	0	0	0	0	0	0	1	0	0	0	2	0	0	7	0	0	3			0		-
			H	0	0	4	0	0	0	0	0	0	0	0	0	m	m	_	0	7	7	m	0	9	9	0	9	0	0	0	6	0	0	0	15 (	15 (		0	0 10		25 0	7
				0					0	9 0	0	0 81	14 0	0	9 0	0 91	0 91	0	6	11 0	0 9	2 0	6 0	9.	9	0 12			0 21		4 0	_	9 0	7 0	0 9			0	8	0 24	0	- 1
alp		ı		28					72 (	25			0	25	24	0	0	0	21	0			20	0 1	0	18			10			16		0	0			24		0		- 1
		1		28 0					27 (			0 34		22 (		0	0 24		21 0										10 0					(r)					_	0	_	_ }
		ı		3					3 0	0	24 0	0 13	0 14	0	0 9	0 16	0 16	0	0	21	9	22	0	16	16	0	13	0	0	0	4	0	0	7	91	91	6	0		4 0		
		-1	49	0	0	4	0	0	0	0	0	0	7	0	0	m	m	7	0	-1	7	m	0	9	9	0	9	0	0	0	6	0	0	0	15	15	σ	0	0	0	25	0
		ı									• •	1 0																											Н			$\sim 1$
		32	80	32	32	32	32	33	32	32	11	32	32	32	32	32	32	32	32	32	32	32	32	32	32	33	32	32	32	32	32	32	33	32	32	32	32	39	32	35	32	32
wlp	rank	38																																								- 1
(1)		3 14048	10272	14008	13952	13952	13984	3928	3928	3928	10600	3920	3920	3912	3912	3826	3888	3888	3832	3792	3792	3920	3816	3824	3856	3736	3792	3720	3976	3896	3792	3880	3800	3664	4112	4144	4048	3608	4520	4440	5328	6744
Wlp (W4,)		648 ]	1224	643 1	640 1	640 1	640 1	635 1	635 1	635 1	1147	632 1	632 1	627 1	627 1	624 1	624 1	624 1	619 1	616 1	616 1	616 1	611 1	608 1	608 1	603 1	600 1	595 1	595 1	587 1	584 1	579 1	571 1	568 1	560 1	560 1	552 1	539 1	515 1	507 1	456 1	379 1
		592	592	597	009	009	009	605	605	605	605	809	809	613	613	616	616	616	621	624	624	624	629	632	632	637	640	645	645	653	929	661	699	672	680					733		- 1
		26,38	39	41	42c	42p	45	20	51b	51a	53	24b	54a	26b	56a	28	29b	59a	61	62	63	64	99	89	69	7.1	73	75	9/	78	79	31	33	34	35	96	38	90	32	34	96	99
Design		33-26.	13-26.	13-26.	13-26.	13-26.	3-26	3-26.	3-26.	3-26	3-26	3-26	3-26.	3-26	3-26.	3-26	3-26	3-26.	3-26.	3-26.	3-26.	3-26.	3-26.	3-26.	3-26.	3-26.	3-26.	3-26.	3-26.	3-26.	3-26.	3-26.8	3-26.8	3-26.8	3-26.8	3-26.8	3-26.8	3-26.5	3-26.5	3-26.5	3-26.5	3-26.9

k = 33, D	k = 33, Designs sorted based on degrees	on ded	0	rreedom used (continued)	n use	200	ובדשמ	eg)												
Design	wlp(w4,)	wlp rank				alp	Ω,						df C	2FI 1	df C2FI Lmax	df rank	C2FI rank	Lmax rank	Lmax CD2* rank	CD2 rank
33-26 101	1085 155 22568	101	63 0 0	0	0	0	0	0	0	0	31	0	127	63	15	42	<del>, -1</del>	73	4.8177	101
22-26 14		14	9		50	30	0	C	C	0	0	-	126	7	16	43	55	75	4.4784	<b>-</b>
33.26.24	540 1120 11630	24		, ,	200		0 0	c			0		126	2	16	44	26	77	4.4871	15
33-26.24	550 1050 11552 576 1048 11552	500	30 0	0 0 12 18 0 0 18 12 0 0 0 0	8 6	000	8 12	0	0	0	0	ı	126 2 16	7	16	45	57	79	79 4.4942	31
00-00-00	20077 0504 070	ì	3																	

k = 33, Designs sorted based on the number of clear two-factor interactions

			rank							alp							_	g G	T # 7	כבנו חוומא	rank	rank	rank	3	rank
33-26 101 1	1085 155	22568	101	63				0	0		0	0	0		1			1		15	42	1	73	4.8177	101
	200	13608	0	300				0	24		0	0	0			7 0				15	37	2	70	4.5456	88
33-26.94	700	14440	9 0					0	c				0		0	ص ص				15	39	က	71	4.5682	
33-20.94	000	16744	7 0			, 6		, c	· C	0			0		0	0		127	35	15	41	4	72	4.6532	
23-26 50	23.7	13928	, r					· C	30				0		0	7				15	7	5	64	4.4962	
23-26.30	200	13736	25					0	2 (2		0		0		0	1				15	25	9	67	4.5121	
33-75 83	27.7	13800	. 0						2 00				0		0	-				15	32	7	68	4.5296	
33-26 38	448	14048	200			· c	, ,	y C	0	8	9	0	-	0	0	0				12	1	80	7	4.4900	
33-26.41	597 643	14008	41	32	0	0	n 0	0	28	0.28		т С	0	0	0	0				11	ო	O	က	4.4924	24

k = 33, Designs sorted based on minimizing Lmax

33-26.42c     600 640 13952       33-26.45     600 640 13984       33-26.41     597 643 14008       33-26.51a     605 640 13928								1							3	1130 15			rank	rank	rank		rank
600 640 597 643 605 635		32	c	0	0	16	0	30 0	16	0	0	0	0	0	12				4	11	1	4.4937	27
597 643 605 635		32			0	16		30 0	16	0	0	0	0	0	12		32 1	0	9	13	7	4.4939	30
605 635		32	· c			0		0 28	0	m	0	0	0	0	12			1	က	Ø	٣	4.4924	24
613 627	50 20	32	0	0	9	0	25	0 25	0	9	0	0	0	0	127		32 11	-	σ	14	4	4.4962	32
		32	0	0	6	0	22	0 22	0	6	0	0	0	0	12			1	13	19	2	4.5004	42
645 595		32	0	0	21	0	10	0 10	0	21	0	0	0	0	12			1	28	33	9	4.5179	72
592 648		32	0		0	ø		48 0	9	0	7	0	0	0	12			2	~1	σ	7	4.4900	21
600 640		32	0	0	0	0		4 0	0	0	4	0	0	0	12			2	4	11	80	4.4937	28
608 632		32	0		0	14	0	0	14	0	~	0	0	0	12		32 1	2	12	16	6	4.4978	39
616 624		32	0	0	3	16	0	74 C	16	0	m	0	0	0 0	12			2	15	20	10	4.5016	44

	125	127	125	125	120	120	120	125	125	127	123	120	120	127	126	126	126	126	126	126	127	127	124	126	124	127	127	124	124	127	127	127	126	127	127	127	127	124	127	121	127
	115	124	115	115	114	114	114	115	115	124	120	114	114	124	123	112	112	112	112	112	124	124	122	117	122	124	124	122		124	4	124	7	124	4	4	4	121	4	7	24
	112	122	112	112	111	113	111	112	112	122	114	801	113	122	112	901	901	97	26	90										122	22	122	12	22	22	22	22	17 1	22 1	12 ]	22
	107	121	107	107	80	11	80	.07	10	21	13	.02		121		. 76	٠.			00	Н			• •	٠.	٠.	121	٠,	٠.	н	•	.21	_	_	-	21 1	21 1	12 1	21 1	07 1	21 1
	04 1		104 1											115 1		95	95	90	90	97 1	115	15 1	б	9	1 60	2	2	07 1	09 1	Ŋ	_	12 1		7	12 1	7 1	7.1	98 1	7.1	8 1	7 1
	03 1	٠,	103 1		٠,	٠,		٠.	٠,	٠.	٠.	٠.	٠,	٠.		84					112	12 1	Н	Н	~	Н	Н	-	-	N	-	07 11		Н	07 11	2 11	2 11	97 6	2 11	97 6	5 11
	٠.	104 1	٠.		93 1(	' '	4.4	_		-	-			107 11							7	Н	Н				4 112			6	-	Н		Н	Н	9 112	9 112		Н		2 11
				98 10		87 9		8 10	8 10	,,,				_		8					4	-			3 104	-		3 100		-	•	3 104		П					-		11;
		8 102				8	80	7	7	-	1 84	3 7		1 104		. 7				8 81	-		98				٠.			m	Н	86		Н		104	104	91	104	91	104
S		4 88	95 9'	6 97			•	9	0 97	8 91		67 73		9 84	9 7	9 75	69 75	69 75	69 75	5 78	4	98 6	9 85	-4	6		7 98					9 85				3 91	88 /	2 87			88
Generator			92 9		_	67 7	_	36 8	36 9	34 8	67 7				26 6	56 6		_		7	88 9	7	7	8 69	7	7 91	94 97	80	62 67		82 87	_	_	81 87		87 88		4 82	7 88	1 82	1 8
ner			98					77					55										67 7					57 7	_	88		_	9		7		9	13 7	11 8	4 8	8 9
			67					_						69		52		52	52							σ				9		299		4	6		•	707	9 9/	73 7	74
sign	9	26	9	9	42	42	42	9	9	26	42	42	42	67	20	20	20	20	20	52	73	67	52	55	20	74	81	59		9/	69	25			ø	74	69	. 69	74.	. 69	69
Desi	58			58	41	41	41	58	58	54	41	41	41	20	49	49	49	49	49	20	70	47	20	52	49	70	77	26	49	69	67	20	20	67	52	67	67	29	29	29	67
	57	53	57	57	m	c		57	57	53	35	35	35	49	44	41	44	44	41	49	62	44	49	20	42	61	67	49	42	61	20	49	49	26	20	26	47	49	59	49	26
	3 54	1 47	54	54		28	28	54	54	47	28	28	28	42	38	38	38	38	38	38	56	42	42	49	38	59	59		38			38	41	47	49	47	44	45	26	45	47
	5	2 44	5 53	53	5 26	26	26	53	5 53	44	26	26	26	41	37	37	37	37	37	37	49	41	38	38	35	2			35			35	m	4	38	44	42	38	47	38	44
	4	4	5 4	5 4(	2 25	2 2	2 2	5.46	5 46	1 42	2 25	2 25	2 25			3 35					47	38	. 35	37	31	49		35	31		41	31		42		42	41	35	44	35	42
	.4	4	4	4		1 2	1 2	5.4	5.4	5.4	1 23	1 2	0	n		5 28					1 42	37				44		31	•			28		41		41	38	31	42	31	41
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			9			3.1	3 1	9 2	9 2	9 2	3 1	3.1	3.1		•	9 2	•	9	• •	9 2	9 2	8	Т	9 2	Н	9 3(	1 2	9 23	3 17	2	7	3 17	2	93	3 14	9	3	22	30	1 22	9
	1	1	1 1	1 1	1	1	7	1 1	1 1	1 1	1	1 1	1	1 1	3.1	3 1	3 1	3 1	3 1	3 1	-	1	1	3 1	1	1	1 2	7	H	7	55	ä	ii ~	<del>~</del>	급 그	7	=	2	7	21	15
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Design	33-26	33-26	33-26	33-26	33-26	33-26	33-26	33-26	33-26	33-26	33-26.]	33-26	33-26	33~26	3-2	3-2	3-2	3-2	3-2	33-26	3-2	3-2	3-2	33-26	33-26.	33-26	$^{\circ}$	2	33-26.	OI I	33-26.	33-26.	33-26	33-26.	33-26.	33-26.	33-26.	33-26.	-2	7	33-26.

k = 33, Design generators (Continued)

35 37 38 41 42 44 47 67 73 74 76 82 88 91 104 107 112 115 121 122 124 1 35 41 42 44 47 56 97 69 74 76 81 87 88 104 112 115 117 121 122 124 1 35 37 38 41 42 44 47 67 74 76 81 87 88 104 112 115 117 121 122 124 1 35 37 41 42 44 47 67 74 76 88 89 79 88 104 110 115 117 121 122 124 1 125 28 31 35 41 56 69 76 86 88 97 98 100 103 104 107 110 112 115 121 122 124 1 19 21 22 26 35 37 38 49 50 56 59 67 69 70 81 82 88 91 104 110 115 117 121 122 124 1 19 21 22 26 35 37 38 49 50 56 59 67 69 70 81 82 88 91 111 112 115 121 122 124 1 19 21 22 26 35 37 38 49 50 56 59 67 69 70 81 82 88 104 110 115 117 121 122 124 1 15 37 37 41 42 44 47 56 67 69 74 81 82 87 88 104 110 115 117 121 122 124 1 135 37 41 42 44 47 56 67 69 81 82 87 88 104 110 115 117 121 122 124 1 135 37 41 42 44 47 56 67 69 81 82 87 88 104 110 115 117 121 122 124 1 135 37 41 42 44 47 56 67 69 81 82 84 87 88 104 110 115 117 121 122 124 1 135 37 41 42 44 47 56 67 69 81 82 84 87 88 104 110 115 117 121 122 124 1 135 37 41 42 44 47 56 67 69 81 82 84 87 88 104 110 115 117 121 122 124 1 135 37 41 42 44 47 69 74 81 82 87 88 93 104 110 115 117 121 122 124 1 135 37 41 42 44 47 69 81 82 84 87 88 104 112 115 117 121 122 124 1 135 37 41 42 44 47 69 81 82 84 87 88 104 112 115 117 121 122 124 1 135 37 41 42 44 47 69 81 82 84 87 88 104 112 115 117 121 122 124 1 135 37 41 42 44 47 69 81 82 84 87 88 104 112 115 117 121 122 124 1 135 37 41 42 44 47 56 67 89 81 82 84 87 88 104 112 115 117 121 122 124 1 135 37 41 42 44 47 69 81 82 84 87 88 93 104 112 115 117 121 122 124 1 135 37 41 42 44 47 69 81 82 84 87 88 93 104 112 115 117 121 122 124 1 135 37 41 42 44 47 69 81 82 84 87 88 93 104 112 115 117 121 122 124 1 135 37 41 42 44 47 56 69 81 82 84 87 88 93 104 112 115 117 121 122 124 1 135 37 41 42 44 47 69 81 82 84 87 88 93 104 112 115 117 121 122 124 1 135 37 41 42 44 47 56 69 81 82 84 87 88 93 104 112 115 117 121 122 124 1 124	35 37 38 49 50 52 55 67 69 70 81 82 84 87 97 98 100 111 112 115 117 35 37 38 49 50 52 55 67 69 70 81 82 84 87 97 98 100 111 112 115 117 35 37 38 49 50 52 55 67 69 70 81 82 84 87 97 98 100 111 112 115 117 3
	21 2 2 2 2 2 2
	33-26.99 7 33-26.101 7
	7 19 22 29 35 37 38 41 42 44 47 67 73 74 76 81 87 88 91 104 107 112 115 121 121 19 30 35 41 42 44 47 56 59 67 69 74 76 81 87 88 104 112 115 117 121 121 121 19 30 35 37 41 42 44 47 67 74 76 81 87 88 91 104 109 112 117 121 121 12 12 52 28 31 35 41 56 67 69 74 81 82 87 88 104 110 115 117 121 12 11 13 21 25 28 31 35 41 56 69 76 86 88 97 98 100 103 104 10 115 117 121 11 19 30 35 37 41 42 44 47 56 69 76 81 82 87 88 104 110 115 117 121 11 11 19 30 35 37 41 42 44 47 56 67 69 74 81 82 87 88 104 110 115 117 121 12 11 19 30 35 37 41 42 44 47 56 67 69 74 81 82 87 88 104 110 115 117 121 12 11 19 30 35 37 41 42 44 47 56 67 69 74 81 82 87 88 104 110 115 117 121 12 119 30 35 37 41 42 44 47 56 67 69 74 81 82 87 88 104 110 115 117 121 12 119 30 35 37 41 42 44 47 56 67 69 81 82 87 88 93 104 110 115 117 121 12 119 30 35 37 41 42 44 47 56 67 69 81 82 84 87 88 104 110 115 117 121 12 119 30 35 37 41 42 44 47 56 67 69 81 82 84 87 88 104 110 115 117 121 12 119 30 35 37 41 42 44 47 56 67 69 81 82 84 87 88 104 110 115 117 121 12 11 119 30 35 37 41 42 44 47 56 67 69 81 82 84 87 88 104 112 115 117 121 12 11 119 30 35 37 41 42 44 47 56 67 69 81 82 84 87 88 104 112 115 117 121 12 11 12 119 30 35 37 41 42 44 47 56 67 69 81 82 84 87 88 93 104 112 115 117 121 12 117 121 12 119 30 35 37 41 42 44 47 56 67 69 81 82 84 87 88 93 104 112 115 117 121 12 117 121 12 119 30 35 37 41 42 44 47 56 67 89 81 82 84 87 88 93 104 112 115 117 121 12 117 121 1

k = 34, Designs sorted based on word length pattern

CD2	dilk	2	٣	4	ស	9	7	80	6	10		П			17	15	16	18	19	19	21
CD2*	4	4.1085	4.1086	4.1111	4.1116	4.1138	4.1138	4.1142	4.1144	4.1152	4.1171	4.1081	4.1176	4.1239	4.1248	4.1242	4.1247	4.1272	4.1277	4.1277	4.1286
Lmax	Tally	1	2	e	10	4	Ŋ	11	9	22	7	23	12	13	14	<b>6</b> 0	15	6	16	16	24
df	Tally	11	12	13	14	15	16	17	18	19	20	7	21	22	23	24	25	56	27	27	29
Lmax		15	15	15	16	15	15	16	15	17	15	17	91	16	91	12	91	15	91	16	17
C2FI I		0	0	0	0	0	0	0		0	0	0						0	• •		
df C		121	121	121	121	121	121	121	121	121	121	127	121	121	121	121	121	121	121	121	121
		0	0	0	0	0	0	0										0			
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		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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		9	9	17	17	0	0	0	27	0	16	0	16	0	0	33	33	0	0	0	0
		20	20	31	33	48	48	20	21		18	0	18	0	0	7	7	24	24	24	24
		24	24	28	24	12	12	80	17	0	25	0	27	48	49	0	0	0	0	0	0
		_	-	4	9	12	12	14	15	18	11	0	7	7	m	24	24	24	26	24	28
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о <del>х</del>	•		٠.						0	-	-	0	0	0	0	0	0	0		0	0
wlp	;	1	7	m	4	S	o	7	00	σ	10	11	12	13	14	15	16	17	18	18	20
<u> </u>		10788	10788	10882	10868	81601	10979	10964	11046	10936	11146	14432	1132	1412	11384	1578	11564	1691	11676	11676	11648
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wld (w4,)		1800	1801	1764	1764	1728	1728	1728	1715	1728	1680	1280	1680	1600	1600	1568	1268	1536	1536	1536	1536
-			_	597 1	٠.	٠.	٠.	606 1	٠.	٠.	• •					٠.			_		648 1
ub		7.1	7.2	7.3	7.4	7.5	9.7	7.7	7.8	6.7	7.10	7.11	7.12	7.13	7.14	7.15	7.16	1.17	1.18a	.18b	7.20
Design		34-27.	34-27.2	34-27.3	34-27.4	34-27.5	34-27.6	34-2	34-27.8	34-27.9	34-27.10	34-27.1	34-27.12	34-27.1	34-27.14	34-27.1	34-27.1	34-27.1	34-27.18a	34-27.18b	34-27.20

k=34, Designs sorted based on degrees of freedom used

Design		wlp (w4,)		wlp						alp									df C2	FI	C2FI Lmax	df	Lmax	CD2*	CD2
																									4
34-27.11	616	616 1280 14432	1432	11	0 32	0	0	0	0	09	0	٥	٦	0	0	0	0	-1	127	0	17	П	23	4.1081	
34-27.21	929	1200 14	1184	21	0 32	o	0	30	0			30		0	0	0	0	Н	127	0	17	7	25	4.1238	13
34-27.23	680	1152 14	1240	23	0 32	0	12 (	0	0			0		0	0	0	0	-	127	0	17	٣	26	4.1342	22
34-27.26	720	1072 14	1504	56	0 38	0	0		0	0	0		0	0	9	0	0		127	0	17	4	28	4.1525	26
34-27.31	976	560 19	9880	31	0 62	0		0	0			0	_	0	30	0	0	-	127	0	17	5	31	4.2919	31
34-27.22	674	1424 12	140	22	0	16 4	14	0	0	0		19 9	0	0	0	0	٣	0	125	0	16	ю	18	4.1410	24
34-27.24	680	1408 12704	104	24	0		22 (	0	0	0	•	4 0	0.4	0	0	0	7	-	125		17	7	27	4.1431	25
34-27.27	730	1200 13	1972	27	0	33 2	24 0	0	0	0	0	0 24		0	0	0	m	0	125	0	16	00	20	4.1639	28
34-27.29	794	1008 15	316	59	0	22	0	0	0	0	0	0	7 28	0	0	0	က	0	125		16	თ	21	4.1941	59
34-27.30	808	896 15	904	30	0 32	0	38	0	0	0	0	0	7 28	0	0	0	7	1	125	0	17	10	30	4.1975	30

k = 34, Designs sorted based on minimizing Lmax

)esign	wlp (w4,)	()	wlp rank							์เช	alp									df C2	CZFI	Lmax	df rank	Lmax rank	CD2*	CD2 rank
34-27.1	589 1800 10788	10788	1	0	0	0	0	34 5	50	10	0	0	0	0	0	9	1	0	0	121	0	15	11	-	4.1085	2
34-27.2	589 1801	10788	2	0	0	0	0	54.5	0	5	0	0	0	0	0	9	М	0	0	121	0	15	12	7	4.1086	ო
-27.3	597 1764	10882	ო	0	0	0	4	28 3	1.17	0 ~	0	0	0	0	0	2	7	0	0	121	0	15	13	m	4.1111	4
-27.5	605 1728	10978	വ	0	0	0	12 1	12 4	48	. 8	0	0	0	0	0	4	m	0	0	121	0	15	15	4	4.1138	9
34-27.6	605 1728	10979	9	0	0	0	12 1	12 4	48 (	8	0	0	0	0	0	4	ო	0	0	121	0	15	16	S	4.1138	7
-27.8	607 1715	11046	œ	0	0	0	15 1	17 2	21 27	0 ~	0	0	0	0	0	4	m	0	0	121	0	15	18	9	4.1144	6
-27.10	615 1680	11146	10	0	0	7	11 2		18 16	9	0	0	0	0	0	m	4	0	0	121	0	15	20	7	4.1171	11
-27.15	637 1568	11578	15	0	0	00	24	0	7 3	8	0	0	0	0	0	Н	9	0	0	121	0	15	24	80	4.1242	15
34-27.17	645 1536	11691	17	0	0	8	24	0	4	7 24	0	0	0	0	0	0	7	0	0	121	0	15	26	<b>o</b>	4.1272	18
34-27,4	1764		4	0	0	0	9	24 3	3 1.	7 0	0	0	0	0	0	9	0	∺	0	121	0	16	14	10	4.1116	S

k = 34, Design generators

	125	125	120	123	126	126	126	120	126	126	127	126	126	126	126	126	126	56	126	26	.27	26	.27	56	56	26	56	26	18
	2	115	V	0	112														112 1									17 1	17 1
	12	12	11	14	11		106								100 1									• •	٠.	12 1	15 1	15 1	15 1
	1 70	1 70	38 1	13 1	1 90	٠.	•	• •		۲-,	,,,								97 1							0 1	2 1	2 1	2 1
																													m
	m																		1 95										10;
	0 1 0																		84										٠.
																			81										
																			75										
	97	97	74	74	78	78	78	74	78	75	87	75	81	81	75	75	69	69	69	69	91	82	86	82	81	82	84	84	87
	92	89	73	73	75	75	75	73	75	69	84	69	78	78	69	69	61	61	61	61	88	81	97	81	69	81	82	82	84
ors							69	67	69	26	79	26	75	75	26	26	26	26	26	26	79	78	94	78	67	78	81	81	82
Generators	1			61															55			69	91	69	26	69	78	69	81
ene	77	67	55	55	55	55	55	55	55	52	70	52	56	26	52	52	52	52	52	52	74	67	88	67	22	67	69	67	70
	67	63	52	52	52	52	52	52	52	20	69	50	55	52	20	20	20	20	50	50	73	26	70	26	52	26	67	99	69
Design	09	9	42	42	50	20	50	42	20	49	67	49	52	52	49	4	49	49	49	49	29	22	67	22	20	52	99	55	67
De	58	28	41	41	49	49	49	41	49	44	20	44	20	20	44	44	44	44	44	44	47	52	26	52	49	52	55	52	28
	57	57	35	35	44	44	41	35	41	41	49	41	49	49	41	41	41	41	41	41	44	20	53	20	44	20	52		22
	54	54	28	28	38	38	38	28	38	38	42	38	38	38	38	38	38	38	38	38	42	49	45	49	41	49	20	49	52
	53	53	26	26	37	37	37	26	37	37	41	37	37	37	37	37	37	37	37	37	41	41	31	41	38	41	49	41	49
	46	46	25	25	35	35	35	25	35	35	38	35	35	35	35	35	35	35	35	35	38	38	28	38	37	38	38	38	44
	45	45	22	22	28	28	28	22	28	28	37	28	28	28	28	28	28	28	28	28	37	37	26	37	35	37	37	37	38
	35	35	21	21	25	25	25	21	25	25	35	25	25	25	25	25	25	25	25	25	35	32	25	32	25	35	35	35	37
	30	30	19	19	22	22	22	19	22	22	30	22	22	22	22	22	22	22	22	22	30	25	22	25	22	25	25	25	35
	29	29	14	14	21	21	21	14	21	21	29	21	21	21	21	21	21	21	21	21	29	22	19	22	21	22	22	22	30
	19	13	13	13	19	19	19	13	19	19	19	19	19	19	19	19	19	19	19	19	19	21	14	21	19	21	21	21	21
	11	11	11	11	13	13	13	11	13	13	11	13	13	13	13	13	13	13	13	13	11	19	11	19	13	19	19	19	19
	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Design	34-27.1	34-27.2	34-27.3	34-27.4	34-27.5	34-27.6	34-27.7	34-27.8	34-27.9	34-27.10	34-27.11	34-27.12	34-27.13	34-27.14	34-27.15	34-27.16	34-27.17	34-27.18a	34-27.18b	34-27.20	34-27.21	34-27.22	34-27.23	34-27.24	34-27.26	34-27.27	34-27.29	7	34-27.31

k = 35, Designs sorted based on word length pattern

Design	W1D (W4,)	wlp								a	alp								đĘ	CZE	C2FI Lmax		df	Lmax	CD2*	CD2	l
		rank									1											н	rank	rank		rank	
35-28.1	665 2100 13020	1	0	0	0	0	0	70,	10	0	0	6	0	0	0	7	0	0	122	0	1	5	8	Н	3.7764	1	
35-28.2	665 2101 13020	2	0	0	0	0	0	70	10	0	0	0	0	0	0	7	0	0	12,	0	-	2	4	2	3.7764	7	
35-28.3	2058	ო	0	0	0	0	18	35	27	0	0	0	0	0	0	9	<del>, -1</del>	0	122	2	-	9	5	ო	3,7790	٣	
35-28.4	2016	4	0	0	0	4	16	36	16	œ	0	0	0	0	0	S	7	0	122	2	-	9	9	4	3.7816	7	
35-28.5	2016	S	0	0	0	9	12	38	16	8	0	0	0	0	0	9	0	_	12	2	-	7	7	ω	3.7820	2	
35-28.6	1960	9	0	0	0	10	22	_	33	œ	0	0	0	0	0	4	n	0	12,	2	-	9	8	Ŋ	3.7848	9	
35-28.7	1920	7	0	0	7	9	24	24		24	0	0	0	0	0	6	4	0	12,	2	-		6	9	3,7876	7	
35-28.8		80	0	0	4	7	56	24	0	74	0	0	0	0	0	4	7	۲	122		17		10	6	3.7880	80	
35-28,9	1792	6	0	0	4	28	0	0	24 2	74	0	0	0	0	0	-	9	0	12,				-!	7	3,7945	6	
35-28.10		10	0	0	4	28	0	0	24 2	74	0	0	0	0	0	4	0	m	12	0			12	10	3.7949	10	
35-28.11	1536	11	0	0	32	0	0	0	0	8	0	0	0	0	0	0	4	က	12			7 1	33	11	3.8090	11	
35-28.12		12	0	0	œ	52	0	0	0	0	0	0 2	4	0	0	0	0	က	12	0	-	7	-1	12	3.8146	12	
35-28.13	840 1344 17248	13	0	0	32	28	0	0	0	0	0	0	0 28	о 6	0	0	0	m	12	9	1	7	2	13	3.8387	13	

k=35, Designs sorted based on degrees of freedom used

Design	wlp (w4,)	) wlp rank	다							.0	alp								ਰ	df C2F	C2FI Lmax		df rank	Lmax rank	CD2*	CD2 rank
35-28.12	776 1600 15712	712 1:	2	0	8	3 52	0	0	0	0	0	0	24	4	0	0		0 3	12	9		7	1	12	3.8146	12
35-28,13	840 1344 17	7248 1	e	0	32	28	0	0	0	0	0	0	0	28	0	0	0	0 3	126	9	0 1	7	2	13	3.8387	13
35-28.1	2100	13020	7	0	0	0	0	70		0	0	0	0	0	0	0	_	0	12	2	1	2	3	-	3.7764	7
35-28.2	2101	13020	2	0	0	0	0	70	10	0	0	0	0	0	0	0	7	0	12	2 (	0 1	5	4	2	3.7764	2
35-28.3	674 2058 13	13140	e	0	0	0	18	35	27	0	0	0	0	0	0	0	9	1 0	12	2 (	0	9	5	ო	3.7790	m
35-28.4	2016	1263	4	0	0	4	16	36	16	80	0	0	0	0	0	0	SO.	2 0	12		0	16	9	4	3,7816	4
35-28.5	2016	13248	5	0	0	9	12	38	16	œ	0	0	0	0	0	0	9	0 1	12	2	0 1	7	7	00	3.7820	ß
35-28.6	1960	1468	9	0	0	0 10	22	7	33	ω	0	0	0	0	0	0	4	3	12		0	16	œ	2	3.7848	ø
35-28.7	1920	13599	7	0	2	رو	5 24		0	24	0	0	0	0	0	0	r m	4 0	12	5	0 1	9	6	9	3.7876	7
35-28.8	1920	13584	80	0	) 4	12	26	24	0	24	0	0	0	0	0	0	4	2	12	2	0	17	10	6	3.7880	œ

k = 35, Designs sorted based on minimizing Lmax

nes r dii	wlp (w4,)	<u></u>	wlprank								alp	_								df (	C2FI	Lmax	k df rank	Lmax	CD2*	*	CD2
35-28.1	665 2100	13020	-	0	c	c	c	c	- 1	10	c	٥	٥		C		7	c	c	122	0	7	٣	-	2 7764	7.7	-
35-28.2	665 2101		2	0	0	0	0		70 1						0	0		0	0	122	0	15	) 4	1 0	3.7764	1 7	10
35-28.3	674 2058	13140	m	0	0	0	0		35 2	7	0	0	0	0	0	0	Ø	-	0	122	0	16	'n	ı m	3.77	06	l M
35-28.4	683 2016	13263	4	0	0	0	4	16	36 1	9	8	0	0	0	0	0	S	2	0	122	0	16	v	4	3.7816	9	4
35-28.6	٠,	13468	9	0	0	0	10	22	7 3	33 8	8	0	0	0	0	0	4	m	0	122	0	16	80	5	3.78	8	ø
18.7	1920	13599	7	0	0	7	9		24	0 24	A.	0	0	0	0	0	٣	4	0	122	0	16	đ	9	3, 78	9/	7
35-28.9	1792	14127	σ	0	0	4	28	0		24 24		0	0	0	0	0	-1	9	0	122	0	16	11	7	3,79	5	ð
35-28.5	2016		Ŋ	0	0	0	9	12	38 1	16 8	9	0	0	0	0	0	9	0	-1	122	0	17	7	00	3,7820	0	Ŋ
35-28.8	1920	13584	<b>c</b> o	0	0	4	7	26	24	0	0	0	0	0	0	0	4	7	Н	122	0	17	10	σ	3.78	00	00
35-28.10	1792	14112	10	0	0	4	28	0	0	24 24	0	0	0	0	0	0	4	0	٣	122	0	17	12	10	3.7949	6	10

k = 35, Design generators

	3 126 3 126 3 126 3 126 3 126 3 126 1 126 1 126 1 126
	112 119 119 123 112 119 112 119 112 119 123 125 119 123 116 121 116 121 116 121 117 119 123
	1111 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
	104 1104 104 1112 1112 1104 1111 109 1111
	101 104 101 101 101 102 104 107 107 107
	88 99 84 88 84 88 88 95 95 101 95 101 97 104 102 104 97 100 97 98
	884 884 882 882 884 888 884 888 998 888 995 995 995 995 995 995 995
	888 888 888 888 888
rs	76 81 74 81 74 76 81 81 82 81 82 81 82 81 82 80 92 80 92 81 85 86 90
erato	74 74 73 74 76 76 76 76 78 78 78
Gen	71 73 73 74 74 75 75 75 75 75 75 75 75 75 75 75 75 75
Design Generators	54 56 54 56 55 4 56 55 6 63 55 6 63 55 6 63 56 63 57 66 58 63 59 63 50 63 51 6
	00000000000000000000000000000000000000
	46 51 46 51 46 51 46 51 46 51 46 51 46 51 51 53 51 53 54 59 54 59
	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
	39 43 39 43 39 43 39 43 39 43 39 43 39 43 39 43 41 42 41 42 41 42 41 42
	288 288 288 288 288 330 330 330
	25 26 25 26 25 26 25 26 25 26 25 26 25 26 27 29 27 29 27 29 27 29 27 29
	15 23 15 23
ub	88.1 88.3 88.4 88.4 88.5 88.5 88.5 88.6 88.6 88.7 88.10
Design	35-28.1 35-28.3 35-28.4 35-28.5 35-28.7 35-28.0 35-28.0 35-28.1 35-28.1 35-28.1 35-28.1

k = 36, Designs sorted based on word length pattern

Design	wlp (w4,)	) wlp rank	٧.						7	ď	alp									,	df C2FI Lmax	H H	Гтах	df ( rank	C2FI rank	Lmax rank	CD2*	CD2 rank
36-29.1	756 2401 15	15736 1	0	0	0	0	0	42	38	0	0	0	0	0	0	0	0	-	0		23	0	16	2	-	1	3.4811	1
36-29.2	352	15890 2	0	0	0	0	12	27	33	ω	0	0	0	0	0	0	0	9	, H				17	m	7	7	3.4837	7
36-29.3	2304	048 3	0	0	0	4	4	48		24	0	0		0	0	0	0	S	2	7 1			17	4	ო	ო	3.4864	ო
36-29.4	2304	032 4	0	0	0	9	0	50	0	24	0	0	0	0	0	0	0	9	0	1 1			18	S	4	9	3.4867	4
36-29.5	2240	16300 5	0	0	0	S	27	0	24	24	0	0	0	0	0	0	0	4	9	1	123	0	17	9	S	4	3.4894	വ
36-29.6	2048	104 6	0	0	0		0	0	0	48	0	0	0	0	0	0	0	٦	9	0 1	23	0	17	7	9	2	3.4987	9
36-29.7	2048	7 880	0	0	0	32	0	0	0	48	0	0	0	0	0	0	0	4	0	3 1	23	0	18	80	7	7	3.4991	7
36-29.8	1792	19264 8	0	0	0		0	0	0	0	0	0	0	28	0	0	0	0	0	3 1	27	0	18	H	œ	80	3.5229	ω

k = 36, Design generators

Design Generators	15 23 25 26 28 39 43 45 46 51 53 54 56 63 71 73 74 76 81 82 84 88 99 101 104 111 112 119 126 15 23 25 26 28 39 43 45 46 51 53 54 56 63 71 73 74 76 81 82 84 88 95 101 104 111 112 119 126 15 23 25 26 28 39 43 45 46 51 53 54 56 63 71 73 76 81 82 84 88 95 101 102 104 111 112 119 126 15 23 25 26 28 39 43 45 46 51 53 54 56 63 71 73 76 81 82 84 88 95 101 104 111 112 119 126 15 23 25 26 28 39 43 45 46 51 53 54 56 63 71 73 76 81 82 84 88 95 101 104 111 112 119 123 125 15 23 25 26 28 39 43 45 46 51 53 54 56 63 71 73 76 81 82 84 88 95 91 104 101 112 119 123 126 15 23 27 29 30 41 42 44 51 53 54 56 63 77 73 76 81 82 84 88 95 97 104 107 109 114 116 119 121 126 15 23 27 29 30 41 42 44 51 53 54 66 63 71 73 78 83 85 86 88 95 97 98 100 104 111 112 119 121 126
Design	36-29.1 36-29.2 36-29.4 36-29.4 36-29.5 36-29.6 36-29.6

Ì,

k = 37, Designs sorted based on word length pattern

Design	wlp(w4,)	wlp									alp	Ω.									df	CZFI	Lmax	df C2FI Lmax df	CZFI	C2FI Lmax CD2*	CD2*	CD2
		Lally																						rank	rally rally	rank		rank
37-30.1	854 2744 18886	1	0	0	0	0	0	21	51	æ	0	0	0	6	0	0	٥		2		24	0	17	1	1	1	3.2166	1
37-30.2	865 2688 19080	7	0	0	0	0	9	0 6 26 24 24	24	24	0	0	0	0	0	0	0	-	0 0 0 0 0 0 0 0 0		124	0	18	2	7	7	3.2191	7
37-30.3	889 2560 19584	m	0	0	0	0	32	0 32 0 0	0	48	0	0	0	0	0	0	0	, ,	(1)		24	0	18	က	m	က	3.2246	m
k = 37, De	k = 37, Design generators			ŀ						],																		
Design								Des	Design Generators	Ger	lera	tor	ß															
37-30.1	15 23 25 26 28 39 43 45 46 51	39 43	45	46		53	54	56	63	17	3 7	4 7	6 8	1 8	2 8	4 8	5	35	66	101	104	111	12 1	19 12	9			
37-30.2	15 23 25 26 28 39 43 45 46 51	39 43	45	46		53	54	26	. 63	11 7	3 7	4 7	9	1 8	2 8	4 8	<u>س</u>	35 1	101	102	104	111	112 1	19 12	9			
37-30.3	15 23 25 26 28	39 43	45	46		54	26	63	71 .	73.7	9 9	1 8	2 8	4 8	8	5	3 10	11 1	102	104	111	112 1	19 1	54 56 63 71 73 76 81 82 84 88 95 99 101 102 104 111 112 119 123 126	9			

k = 38, Designs sorted based on word length pattern

Design	wlp (w4,)	wlp rank								ro	alp									df (	2FI	df C2FI Lmax df Lmax rank rank	df rank	Lmax rank	CD2*	CD2 rank
38-31.1 38-31.2	959 3136 22512 971 3072 22752	1 2	00	00	00	00	0 0 7 49 24 0 0 0 0 0 0 0 0 0 0 7 0 0 0 0 0 0 0 0	7 4	0 48	0 0	00	00	00	0 0	0 0	0 0	00	7	0 1	125	00	18	7 7	1 2	2.9795	1 2

## k = 38, Design generators

Design	Design Generators
38-31.1 38-31.2	15 23 25 26 28 39 43 45 46 51 53 54 56 63 71 73 74 76 81 82 84 88 95 99 101 102 104 111 112 119 126 15 15 3 54 56 63 71 73 74 76 81 82 84 88 95 101 102 104 111 112 119 125 126

k = 39, Designs sorted based on word length pattern

CD2 rank	1
Lmax CD2* CD2 rank rank	2.7671
Lmax rank	п
	1
df C2FI Lmax df rank	19
C2F1	0
df	126 0
	7
	0
	0
	0
	0
	0
	0
alp	0
ro .	0
	32 48 0 0 0 0 0 0 0 0 0 0
	32
	0
	0
	0
	0
wlp rank	г
	56
_	1071 3584 26656
V4 r	584
1p (v	1 36
wlp(w4,)	107
Design	19-32.1
De	39

k = 39, Design generators

Design Generators	1 15 23 25 26 28 39 43 45 46 51 53 54 56 63 71 73 74 76 81 82 84 88 95 99 101 102 104 111 112 119 123 126
Design	39-32.

k = 40, Designs sorted based on word length pattern

CD2 rank	1
df C2FI Lmax df Lmax CD2* CD2 rank rank rank	2.5767
Lmax rank	1
df rank	H
Lmax	20
C2FI	0
df	127 0 20
	7
	0
	0
	0
	0
	0
	0
ф	0
alp	0
	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
	0
	0
	0
1	0
wlp rank	1-1
	360
7	5 31
wlp (w4,)	4096
wlp	1190 4096 31360
Design	40-33.1

k = 40, Design generators

	23 125 126
	6 51 53 54 56 63 71 73 74 76 81 82 84 88 95 99 101 102 104 111 112 119 123 125 126
tors	4 76 81 82 84 88 95 99 1
Design Generators	46 51 53 54 56 63 71 73 7
	15 23 25 26 28 39 43 45
Design	40-33.1

## Vita

Robert M. Block is a 1987 National Merit Scholar. He graduated with Military Distinction from the United States Air Force Academy with a Bachelor of Science in Operations Research. He earned a Master of Science in Operations Research from the Industrial and Systems Engineering College at Georgia Tech. He received his Doctorate in Business Administration with a concentration in Statistics from the University of Tennessee, Knoxville.

Rob has experience as a Logistics Operations Research Analyst, and as a Financial Analyst. He has worked as a Logistics Research Analyst for Air Force Materiel Command Headquarters in Dayton, Ohio, as the Chief of Financial Analysis for the 39<sup>th</sup> Wing, Incirlik AB, Turkey, and as an Assistant Professor and Course Director in the Math Department at the United States Air Force Academy. He has been a command briefer for Air Force Materiel Command, and a Technical Editor for the Air Force Scientific Advisory Board.

Rob is a Distinguished Graduate from the Air Force Financial Management (Analysis) Officer Course, a Chief of Staff Award Winner at Squadron Officer School, and was named the 1997 USAFE Financial Analysis Officer of the Year. He was awarded the 1998 Distinguished Performance in Budgeting from the American Society of Military Comptrollers. He was honored as the 1999 Company Grade Officer of the Year for the Academy Math Department. He has also received the University of Tennessee's 2003 Provost award for Extraordinary Professional Promise. He has been awarded the Air Force Meritorious Service Medal with two oak leaf clusters.